

A Textbook of **OBSTETRICS**

BY

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R This book cannot be issued for house reading

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P R E F A C E

I have endeavoured to reflect in this volume my clinical and teaching experience of thirty years. The main purpose of this book is to present to the undergraduates and junior practitioners the essentials of obstetric practice. I would like to acknowledge the advantages derived by me from constant association with undergraduates and postgraduates. Knowing and discussing with them their difficulties in understanding and practising the art of obstetrics has helped me in composing the subject matter.

In the *economically developed countries* having well organised universal prenatal, intranatal and postnatal care, the hazards of childbirth have been remarkably reduced. The same is comparably true for the well equipped institutions in the cities of India, but, in rural areas obstetric care and management is most unsatisfactory and is likely to remain so for a number of years until the successive five-year plans change the existing pattern. It is, therefore, important to teach the present generation of would-be doctors and those already in practice not only the art of obstetrics as it is practised today in well equipped maternity hospitals but also the management of cases in rural areas having scant obstetric facilities. It is for this reason that I have described the management separately as is practised in maternity institutions and in the rural areas.

The Nowrosjee Wadia Maternity Hospital is one of the large maternity institutions of India. It has on its staff experienced obstetricians. My association with this Institution has been for twenty five years and I could not do better than present the clinical and statistical data of this Institution. Comparative clinical data from other centres in India and from abroad have also been given. The photographs of the specimens are mostly from the Museum of the Nowrosjee Wadia Maternity Hospital.

The text has been divided into fourteen sections. Instead of the conventional way of numbering the chapters serially from the beginning to the end, the chapters in each section have been numbered from one onward. Owing to the difficulty in obtaining

art paper, the text has been printed on offset paper and for the photographs and microphotographs art paper has been used. This has necessitated arranging the plates pertaining to a chapter in one place. I regret the inconvenience to the reader in referring to and fro the text and the plates, but I hope that this arrangement will compensate by giving the reader visual impression of the subject at one glance.

I have great pleasure in acknowledging my indebtedness to several of my medical colleagues and friends. Dr. M. N. Parikh, Assistant Professor in Obstetrics and Gynaecology of the Grant Medical College, has at my request written the Chapters on Toxæmias of Pregnancy, Contracted Pelvis, Radiology in Obstetrics, Obstetric Forceps and Vacuum Extractor. Besides, he has offered valuable help for other parts of the Text. Dr. Mrs. Jer R. Patel, Honorary Paediatrician to the Wadia Maternity and Wadia Children's Hospitals, has contributed Section XIII, The Newborn. Miss Tehmino Moos, Physiotherapist to the Breach Candy Hospital, Bombay, has written the Chapter on Antenatal and Postnatal Exercises. I thank Mrs. Moni Toroporewala, Professor of English, Siddharth College, for making necessary changes in the language; Dr. H. S. Mehta, Honorary Medical Secretary, The B. D. Petit Parsee General Hospital for consenting to include the photograph of the Labour Room of the Hospital and those of the clinical patients; Miss Bhukhoo Wadia for taking the photographs; my wife, Miss Roshan Wadia and Miss Pillai Bharucha for drawing the diagrams.

My esteemed Senior Colleague, Dr. Jhirad, has gone through the manuscripts and her close scrutiny of the text has helped in enriching the subject matter. Dr. Miss Gool Vazifdar has, as always, given her help and advice in the arrangement of figures and plates. Dr. Miss M. K. Motiwala has helped me in the correction of manuscripts and proofs. I cannot express sufficiently my gratitude to my dear friend, Mr. M. R. Mullan, without whose help I would never have been able to publish this book.

I am grateful to my Publishers and the Staff of the Popular Press for their courtesy and co-operation.

K. M. MASANI

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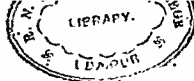
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SECTION I

EARLY PREGNANCY AND THE PLACENTA

CHAPTER 1

OVARIAN AND UTERINE CYCLE

Each month, during the reproductive years of a woman's life, co-ordinated complex changes occur in the ovary and the endometrium. The changes in the ovary have the dual role of ripening and discharging an ovum, and of producing ovarian hormones. The endometrium, under the influence of ovarian hormones, undergoes changes to provide a suitable bed for the implantation of a fertilized ovum. In the absence of fertilization, breakdown changes occur in the endometrium which terminate the cycle by desquamation of the endometrium—outwardly manifested as menstruation. For descriptive purpose, the changes in the ovary and in the endometrium are separately given, but, essentially, they have the one common objective of propagating the species.

The phenomenon of menstruation in humans provides for fertilization and conception to occur regularly all the year round. Menstruation occurs only in women and higher apes. In many mammals, the sex cycles occur at certain intervals during the year. This phenomenon is known as *oestrus*. It is during *oestrus* that a female receives a male; and conception can occur only during the *oestrus* phase.

In the majority of regularly menstruating women, an ovum is regularly ripened, and discharged for fertilization. In some, however, though menstruation occurs, an ovum is not discharged from the follicle for fertilization.

The duration of a menstrual cycle is calculated from the first day of one menstrual flow to the first day of the following one. A complete cycle consists of a bleeding phase, a phase of ripening of a primordial follicle and discharging of the matured ovum, and a phase of development of corpus luteum.

Cyclic Changes In Ovary

Development of Follicle. During each menstrual cycle, several primordial follicles begin to develop, but, for some unknown reason, only one of them continues to develop at a rapid rate, while the growth in the remaining follicle is arrested. These blighted follicles undergo degenerative changes, and finally become atretic follicles.

The primordial follicle has a simple structure. A single layer of flattened epithelial cells encloses the oocyte. As the follicle develops there is proliferation and stratification of the follicular epithelium, now known as granulosa. The follicular growth soon becomes eccentric so that the oocyte becomes displaced to one side of the follicle, and is attached to the wall of the follicle by discus proligerus or cumulus oophoricus. The ovarian stroma surrounding the developing follicle increases in size, and differentiates into two layers, the *theca externa* and the vascular *theca interna*. The follicle now consists of the following structures (Plate 1).

The *theca externa* has no physiological function, and does not differ in structure from the ovarian stroma.

The *theca interna* is physiologically important, as it has the same embryonic derivation as the granulosa, and is under hormonal control. In a developing follicle, the theca cells increase in size, have a granular appearance, and are rich in lipoid material. During advanced stages of follicular development, these cells are known as *theca lutein* cells. As the follicle matures, the cells of the *theca interna* have an eccentric proliferation forming a theca cone,—the apex of the cone being always directed towards the surface of the ovary. According to Strassmann, this formation of cone is to be regarded as tropism directing the follicle to the nearest point on the surface of the ovary. The *theca interna* is very vascular, and forms a vascular network around the granulosa.

Membrana Granulosa. As the follicle grows, the granulosa cells become cuboidal and several layers thick. The cells, in relation to the *theca interna*, are many layered, and form a cone, the apex of which is towards the centre of the follicle. This cone of granulosa cells is known as *cumulus oophoricus* or *discus proligerus*. The ovum is situated towards the apex of the discus proligerus, but is separated from the follicular cavity by several layers of cells known as *corona radiata*. There are no blood vessels in the granu-

losa which receives its blood supply from the network of blood vessels of theca interna.

Follicular Cavity. The follicular cavity increases with maturation of the follicle, and contains an albuminous fluid, liquor folliculi, composed of transudate from the blood vessels, and the follicular hormone secreted by the granulosa cells. A clear elastic mucoid membrane surrounds the ovum, known as the zona pellucida.

Ovum. It has a vitelline membrane, a nucleus and a nucleolus.

Ovulation. (Rupture of Follicle). At the time of ovulation, the follicle comes to the surface of the ovary, the intra-follicular pressure rises, and the blood vessels of the peri-follicular vascular plexus, lying in apposition to the surface of the ovary, become compressed. Ischaemic necrosis at this area causes tissue dissolution in the region, with rupture, through which the ovum escapes. The rent on the ovarian surface after rupture of the follicle is plugged by a blood clot. The walls of the follicle collapse, and a corpus luteum begins to be formed.

Time of Ovulation. As the life span of the discharged ovum is not more than 24 hours, the time for fertilization is very short. As the life span of spermatozoon is also limited, the timing of coitus, particularly in sterile women, is important. Though there are several indirect reliable tests to indicate whether ovulation has occurred, the time when ovulation occurs cannot be determined.

Corpus Luteum. There are four stages in the development of corpus luteum: (1) proliferation or hyperaemia, (2) vascularization, (3) maturity, and (4) regression.

Stage of Proliferation or Hyperaemia. Contrary to the old view, bleeding at the time of rupture of the follicle is slight, because the blood capillaries do not extend any further than the theca interna, and the granulosa is avascular. Except for the zona pellucida and some of the cells of the discus proligerus, all the other granulosa cells are left behind in the collapsed follicle. The corpus luteum, at this early stage, is a collapsed vesicle with thin walls which are not convoluted, and is greyish yellow in colour, in contrast to the bright yellow mature corpus luteum. The granulosa cells do not as yet contain the lipoid material, and the greyish yellow colour is due to the polyhedral theca interna cells containing the lipoid material.

Stage of Vascularization. The corpus luteum is now dark grey, and protrudes above the surface of the ovary. Three changes

characterize this stage. (1) Thin-walled capillaries from the vessels of the theca penetrate vertically through the granulosa towards the lumen. Some of the capillaries open into the lumen, and fill it with blood. (2) The granulosa cells enlarge, become polyhedral, and contain fat and lutein pigment. (3) The theca cells regress, lose their pigment, and present an appearance of ordinary connective tissue. They push inwards along the blood vessels, and form trabeculae which divide the granulosa into large compartments.

Stage of Maturity. The mature corpus luteum is about half an inch in diameter, and is usually situated on the surface of the ovary, but sometimes below it. On section, the lutein zone is convoluted, broad, and frequently yellow in colour. The cavity is small, and contains a small quantity of clear or blood-stained fluid.

The lutein zone is very broad, and the lutein cells are large, polyhedral, and contain poorly staining spheroidal nuclei. They contain blood and fat pigment. The capillaries are increased in number. The cells of the theca interna decrease in number, and are transformed into epitheloid cells (Plate 2).

Stage of Regression. The vascularity is diminished, and the lutein cells decrease in size, become vacuolated, and finally disappear. Connective tissue is increased, and obliterates the cavity. In some cases the cavity becomes cystic. Finally, hyaline degeneration begins, and in a few weeks a corpus albicans is formed. In the course of a few months, it is very much decreased in size; but a cut section, even at this late stage of regression, shows a central fibrotic zone surrounded by a convoluted lutein zone.

From his studies of hormonal activity, Brewer concludes, that degeneration of the corpus luteum commences from about the twenty second or the twenty third day of the cycle. Corner, from his studies in the rhesus monkey, is of the opinion that retrogression begins two or three days before the onset of menstruation.

Corpus Luteum of Pregnancy. Once fertilization has occurred, the corpus luteum remains functionally active for a variable length of time.

The secretion of gonadotrophins by the chorionic villi maintains the corpus luteum in an active state. It was once believed that the corpus luteum was necessary for the maintenance of pregnancy until the formation of the placenta, but it has now been proved, that excision of the corpus luteum early in pregnancy, does not lead

to abortion in every case. An actively functioning corpus luteum is, however, necessary for the successful embedding of the ovum.

Cyclic Changes in Endometrium

The endometrium consists of a narrow deeper basal and a broader superficial functional part. The functional part consists of a deeper spongy and superficial compact layer. There are four components of the endometrium: the *surface epithelium*, the *glands*, the *stroma* and *blood vessels*, each of which undergoes continual changes during a menstrual cycle. The growth changes in the endometrium are divided into preovulatory and postovulatory.

Preovulatory Changes. Preovulatory changes consist of an initial stage of repair, and a later stage of proliferation (Plate 3).

Stage of Repair. Repair commences during the latter part of menstrual bleeding, and is completed within a day or two after menstruation. During menstruation, the *surface epithelium* is shed, but the surface is very soon completely epithelialized from columns of epithelial cells growing out from the stumps of the glands. The cells of the *surface epithelium* are low columnar and ciliated. The glands are simple, tubular, with a narrow lumen, and run perpendicular to the surface. The cells lining the glands are low cuboidal, and there is a well-defined basement membrane. The *stroma* is composed of closely packed round or oval cells. The cell nuclei are large, and occupy the greater part of the cells with a very thin rim of cytoplasm around them. The blood vessels, *spiral arterioles*, are present in the deeper part of the functional layer, and there are few coils in it. The number of collecting veins and arterio-venous anastomoses is small. The superficial part of the endometrium is relatively avascular.

Stage of Proliferation. After initial repair, the endometrium continues to proliferate until ovulation occurs. The *surface epithelium* becomes tall at about the time of ovulation. The glands become hypertrophied, and their lumina are increased. The cells lining the glands are of tall columnar type, and stain well. There is no evidence of secretion, either within the cells or in the lumen. The *stroma* is dense, and is composed of round or oval cells in which the nuclei occupy most of the cell. The *spiral arterioles* are more coiled, and extend almost upto the surface of the endometrium. The number of collecting veins and arterio-venous anastomoses is also increased.

Postovulatory Changes. The phase commences from the time of ovulation and continues till desquamation sets in, and menstrual bleeding occurs. It also consists of two stages: *secretory* or *luteal* and *premenstrual* stage (Plate 4).

Secretory or Luteal Stage. During this stage, a corpus luteum is formed in the ovary. It is a period of endometrial growth, supplemented by preparatory changes for possible embedding of a fertilized ovum. The surface epithelium becomes still taller, the glands are convoluted, 'corkscrew' shaped, and convolutions increase as the stage progresses. The cells lining the glands are at first tall but gradually get shorter. Their margins become irregular, and do not stain well because of vacuoles between the basement membrane and nuclei. The stroma is of a loose character due to oedema and increased vascularity. The cells are larger in size than in the preovulatory stage, and the nuclei are smaller and surrounded by a definite ring of cytoplasm. The spiral arterioles are very much coiled, and the coiling increases as the stage progresses. The number of collecting veins and arterio-venous anastomoses increases.

Premenstrual Stage. The endometrium ceases to grow about five days before the onset of menstruation. There is a striking reduction in the thickness of the endometrium due to resorption of stromal oedema, and loss of glandular secretion. The spiral arterioles are extensively coiled. There are numerous arterio-venous lakes near the ends of the coiled arterioles. The collecting veins are maximum in size and number. The glands collapse, and the size of the cells, which line the glands, is reduced. The stroma becomes dense and infiltrated with leucocytes.

Bleeding Phase. This usually lasts for 3-4 days. The endometrium is shed in fragments. The compact layer and a variable thickness of the spongy layer are usually lost.

Sex Hormones

The pituitary gland, particularly the pars distalis of the anterior lobe, is the controlling gland for the entire endocrine system. Not only does the pars distalis control the secretory activity of the other glands, but the hormones secreted by these glands in turn regulate the pituitary function. This mechanism is essential for maintaining a balance between the pituitary and the other endocrine glands.

The chromophile cells secrete anterior pituitary hormones. The

acidophile cells produce the growth, luteinizing, lactogenic and follicle stimulating hormones. The basophile cells produce adrenocorticotrophic and thyrotrophic hormones. These six hormones have been obtained in completely, or almost completely, pure form in the laboratory, but that does not prove that they are produced by the pituitary gland as six separate hormones. Collip is of the opinion that there are not more than three hormones produced by the pituitary. Each of them is composed of a complex protein molecule which undergoes "dissection", and produces the multiple functional effects in the body. It is likely that the acidophile and basophile cells each produce one composite molecule which whilst being utilised splits off into different hormones.

Gonadotrophins. Upto 1941 two gonadotrophins, follicle-stimulating (FSH) and luteinizing (LH), were known. Since 1941 a third gonadotrophin, luteotrophin, is postulated. Gonadotrophins have been isolated from the anterior pituitary gland of pigs and sheep, from the serum of pregnant mares, and from the urine of pregnant women. Gonadotrophins are glycoproteins, that is a protein molecule with a hexose sugar and a hexosamine. Two of the purest preparations are FSH from the pregnant mare's serum, and LH from human pregnancy urine. The activity of these hormones is destroyed by enzymes such as pepsin and trypsin. These hormones are necessary for the development of the graafian follicle and the corpus luteum. The luteotrophic hormone is essential for the maintenance and the functioning of the corpus luteum.

Pituitary gonadotrophins, by causing the ovary to secrete oestrogen and progesterone, indirectly control the growth and the functions of the reproductive system. Maturation of the follicle, ovulation, and the formation of the corpus luteum are controlled by the gonadotrophins in the following way.

Early follicular development is not stimulated by FSH but by oestrogen or, as in the monkey, by androgen. It is not known whether androgens of the adrenal cortex have similar action in the humans.

Further growth and maturation of the follicle is stimulated by FSH. As the oestrogen concentration rises, FSH secretion of the pituitary is inhibited. However, FSH by itself is unable to cause ovulation.

Ovulation occurs as a result of synergistic action of FSH and LH, but the quantitative ratio of the two that produces ovulation

is not known. There is evidence that the androgens are in some way important in causing ovulation.

Formation of the corpus luteum is stimulated by the LH. It is postulated that the initiation and maintenance of secretory activity of the corpus luteum is caused by the third gonadotrophin, luteotrophin.

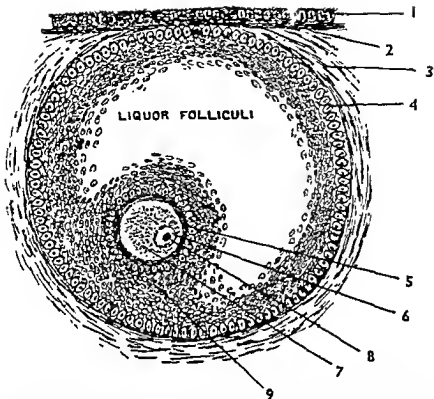
Oestrogens. The natural oestrogens are steroid compounds having a cyclopenteno-phenanthrene group, and are structurally related to the steroid hormones of the testes and the adrenal cortex. They are soluble in oil, ether, and alcohol, but are insoluble in water.

Oestrogen is a collective term for all substances having oestrogenic properties. There are three oestrogens; oestradiol, oestrone and oestriol. Oestradiol is the parent hormone produced by the ovary, while oestrone, and oestriol, represent metabolic or excretory products of oestradiol.

Although the chemical nature of the oestrogens of human ovaries is not known, oestradiol, oestrone, and oestriol have been isolated in crystalline form from the urine of pregnant women, and from the placenta. It is likely that metabolism of oestrogens is probably different in pregnant and non-pregnant states. Oestrone is about ten times as active as oestriol.

During the last fifteen years, a number of chemical compounds having oestrogenic properties have been synthetically prepared. The most important ones are diethylstilboestrol, hexestrol and triphenyl-chlorethylene. These synthetic compounds have no chemical similarity to the ovarian steroids, and do not have a phenanthrene cyclopentane nucleus.

Metabolism of Oestrogens. There is considerable evidence to indicate the liver as the chief organ in the intermediary metabolism of oestrogens. A small portion of the oestrogen circulating in the blood is free oestrogen which can be measured by biological assay methods, but the rest of it is bound with plasma proteins. Oestrogen is removed from the blood stream into the liver, where part of it is converted into oestrone and oestriol, while the remainder is inactivated by hepatic enzymes. Poisoning the liver by carbon tetrachloride reduces the rate of inactivation, and there is evidence that vitamin B deficiency retards the process of inactivation. The syndrome of gynaecomastia with hepatic cirrhosis, is due to the retarded inactivation of oestrogen. Experimentally, oes-



Pl-1. Photomicrograph of Graafian follicle. (1) Germinal epithellum. (2) Tunica albuginea. (3) Stroma capsule. (4) Epithelial lining. (5) Zona radiata (6) Germinal vesicle. (7) Ovum (8) Germinal spot (9) Discus proligerus. (p. 2)



Pl-2. Photomicrograph of corpus luteum. (p. 4).



Pl-3 Photomicrograph of proliferative phase of endometrium (p. 5).



Pl-4. Photomicrograph of secretory phase of endometrium, (p. 6).

trogen is rapidly inactivated by heart-lung-liver preparations, but not by heart-lung preparations.

From the liver, oestrone and oestriol appear in the bile, and after passing through the bile duct, are reabsorbed into the portal system. This has been studied in dogs with a biliary fistula, and also by radio-active dibromosterone which is found to be localised in the gall bladder.

Unlike the natural oestrogens which are rapidly metabolized by the liver, the synthetic oestrogens are much more resistant to inactivation by the liver, and are therefore active when given orally.

Functions of Oestrogens. The most important function of oestrogens lies in maintaining the secondary sex characters, and maturity of the genital organs from adolescence till menopause. At adolescence, the characteristic feminine distribution of hair, the hypertrophy of the breasts, and the development of the external and internal genital organs, are directly influenced by oestrogens. The defeminization and, later, masculinization of the female, with masculinizing tumours of the ovary, are the most convincing evidence of the influence of oestrogens in a normal adult female.

Cyclic changes occur not only in the endometrium, but also in the vagina, the cervix and the Fallopian tubes.

With the commencing degeneration of the corpus luteum, the inhibition imposed by oestrogen on production of FSH is lifted, and FSH stimulates the development of a primordial follicle. As the follicle develops, oestrogen is secreted in increasing amounts and, at about the time of ovulation, as much as 60 International Units per litre of blood is secreted.

There is a slight fall in the level of the blood oestrogen for a short time after ovulation, during the transitory period of the conversion of the ruptured follicle into the corpus luteum. From the time of maturity of the corpus luteum until its regression, the oestrogen level is again raised. As the corpus luteum commences to degenerate, the level of oestrogen drops from 60 I.U. to 30 I.U. per litre, and is maintained at 30 I.U. throughout the regression of the endometrium, and menstruation. As the follicles for the next cycle commence to ripen, the level of oestrogen is once again raised.

Progesterone. It is a steroid hormone containing the cyclopentano-phenanthrene ring nucleus. It exists in two crystalline forms, alphaprogestosterone, melting point 128°C. , and beta-progesterone,

melting point 121°C . It is insoluble in water, but is soluble in many oils and is therefore prepared for injection in an oily solution.

Progesterone has been isolated from the corpus luteum of lower animals, and it is probably secreted by the granulosa lutein cells, as well as the theca lutein cells. Progesterone has also been recently isolated from extract of the placenta and it is believed that it is produced in the syncytial cells of the chorionic villi. It has been synthetically prepared from cholesterol, dihydroandrosterone, and from various pregnane derivatives.

Metabolism of Progesterone. The main product of progesterone excreted in the urine is a biologically inactive substance known as glucuronide of pregnanediol. The intermediate metabolism of progesterone is not definitely known, but recent evidence shows that in the liver, pregnanediol is conjugated with glucuronic acid. Of a known quantity of progesterone given during the luteal phase, only 20 to 30% is excreted in the urine as glucuronide of pregnanediol.

Actions of Progesterone. The main function of progesterone is to prepare the endometrium for nidation of a fertilized ovum, and for continuation of pregnancy. During the early weeks of pregnancy, the corpus luteum of pregnancy secretes progesterone, but after the third month it is produced by the syncytial cells of chorionic villi. The characteristic endometrial changes have already been described.

The frequency and amplitude of the uterine contractions are diminished in rabbits, but not in guinea pigs, rats, and cats. Until recently, it was believed that progesterone had an inhibitory effect on the human uterus, and it was given as a routine for threatened abortion, but this action has been questioned by several investigators.

There is no definite action of progesterone on the vagina, and the cervix. It is supposed to decrease the motility of the Fallopian tubes.

CHAPTER 2

MATURATION OF OVUM, FERTILIZATION, SEX DETERMINATION AND SEX DIFFERENTIATION

Maturation of Ovum. A nearly mature ovum has the following structure: (1) A corona radiata; (2) a zona pellucida; (3) a perivitelline space; (4) a small clear-zone of protoplasm; (5) a firmly granulated broad zone of protoplasm; (6) a central deutoplasmic zone; and (7) the germinal vesicle with its germinal spot.

Just prior to ovulation, certain changes begin to occur in preparation for the reception of the sperm. The nucleus approaches the surface and undergoes karyokinesis. Two elements within the nucleus play a part in the process: the *chromatin* which stains, and the *achromatin* which does not stain. In the resting phase, the chromatin is scattered as minute particles within the nucleus, but, when the cell is about to divide, the particles unite into filaments. The filaments break up into segments or rods, each rod being known as a *chromosome*. As the chromosomes form, the achromatin forms within the cell body just outside the nucleus, the *centrosome*, which plays an important part in the division of the nucleus. The centrosome divides; the two halves move apart, until they lie at the opposite poles of the nucleus where each forms an *attraction sphere*. The attraction spheres become joined by a spindle of achromatin threads. The chromosomes now appear to be supported by the spindle between the attraction spheres. The chromosomes now divide longitudinally; the two halves lying side by side in the equatorial plane (Fig. 1).

In the human, there are 46 chromosomes, 22 pairs of autosomes (body chromosomes), and 1 pair of sex chromosomes. The ovum undergoes two karyokinetic divisions before fertilization.

In the first maturation division, each member of the chromosomes divides, so that the full number of chromosomes goes to each part. The division of the cell body is very unequal; a minute part, known as the *first polar body*, is formed, the other major portion of the cell body is known as *secondary oocyte*. The first polar body lies in the perivitelline space between the ovum and the zona pellucida.

After the first maturation division, the chromosomes are im-

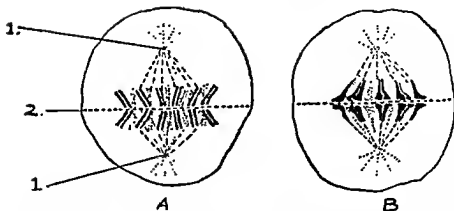


Fig. 1. A. Diagram of Karyokinesis in a somatic cell. 1. Attraction sphere. 2. Line of Division. B. Diagram of Karyokinesis during the production of matured ova and spermatozoa.

mediately regrouped into pairs, and are arranged in the equatorial plate of a mitotic figure. The mitotic spindle remains at the surface of the secondary oocyte until the spermatozoon enters. The second maturation division occurs with the formation of a second polar body. The paired chromosomes separate so that half go to the second polar body, and the other half remain in the matured egg which is now termed ootid. The number of autosomes is thus reduced to 23. One of the pair of sex chromosomes goes to the ootid. Thus, the ootid has only half the developmental potentialities, the other half having been lost in the second polar body.

Similar changes occur in the maturing spermatocyte, so that only half of the original number of chromosomes are present in the mature spermatozoon.

At fertilization, the original number of chromosomes is restored. In this way, the peculiar body characters are transferred equally from the male and the female. The members of the pairs of chromosomes are distributed at random in the second maturation division. As a result, the offspring comes to resemble the mother in some respects and the father in others.

Fertilization. The human ovum is normally fertilized near the fimbriated end of the Fallopian tube. The manner in which the mature ovum and the spermatozoa reach the outer part of the tube is given below.

Transport of Ovum. The ovary lies in a depression called the ovarian fossa. The ampulla of the tube opens outwards in numerous fine projections known as fimbriae. One of the fimbriae is

attached to the ovary, and is known as the ovarian fimbria. The fimbriae are covered by delicate ciliated epithelium. The movements of the cilia are such as to propel the ovum discharged from the surface of the ovary into the lumen of the tube.

Generally, the ovum discharged from the ovary enters the tube of the corresponding side, but, sometimes, it enters the tube of the opposite side. In animals having bicornuate uteri, it frequently happens that the corpora lutea from which the ova came are in the ovary of the side opposite to the gravid horn. This process is known as *migration of the ovum*. Migration of the ovum may be *external* or *internal*.

External migration of the ovum is a phenomenon in which the ovum discharged from one ovary migrates across the pelvic cavity and enters the tube of the opposite side. In women, conception in the rudimentary horn of a bicornuate uterus is usually by external migration of the ovum. A recent case by Wenner provides convincing proof of the external migration of the ovum. A woman who had her right tube and left ovary excised, conceived thrice after this procedure.

Internal migration of the ovum is said to occur, when the ovum discharged from the ovary passes down the tube of the same side, crosses the uterine cavity, and enters the tube of the opposite side. Internal migration of the ovum has not been proved in women.

Transport of Spermatozoa. Vaginal acidity quickly destroys the motility of the sperms. It is likely that in most cases the spermatozoa ejaculated directly on to the external os, are the ones which retain their viability in the presence of *glairy*, alkaline cervical mucus. Cervical mucus varies in consistency during the cycle, and at mid-interval it is translucent and of a thinner consistency than during the rest of the cycle. The spermatozoa pass along the cervical and uterine cavity into the tube by their motility. Recent observations show that mammalian spermatozoa move at a rate of about 3 mm. per minute. Calculated at this rate, it would take about 65 to 75 minutes to reach the ovum in the outer half of the tube. Since the current of ciliary movement in the tube is towards the uterus, the spermatozoa have to swim against the current, and probably take much longer to meet the ovum. Besides, the motility of the sperms, the musculature of the genital tract also helps their travel along the genital canal.

There is evidence that in mammals a considerable number of spermatozoa surround the ovum. Several attempt to penetrate the

zona pellucida to reach the ovum; but only one of them succeeds in fertilizing the ovum.

Sex Determination and Differentiation. In the human species the two sex chromosomes in the female have an identical structure (termed XX), but the structure of the chromosomes in the male differ (termed XY). It is, therefore, obvious that after the maturation division, all the eggs would contain 22 autosomes and one X chromosome; while the spermatozoon would also contain 22 autosomes, but either X or Y chromosome. If the fertilizing spermatozoon contains X chromosome, the embryo will possess the cells with a pair of XX sex chromosomes and be a genetic female, while the impregnation of an ovum by a Y containing spermatozoon produces cells with a pair of XY sex chromosomes,—thus determining the development of the embryo as a genetic male (Fig. 2). Accord-

HOW THE CHROMOSOMAL SEX IS DETERMINED

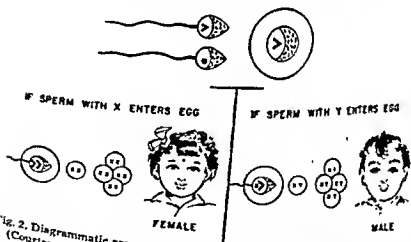


Fig. 2. Diagrammatic representation of how the chromosomal sex is determined (Courtesy: Dr. P. N. Shah, Indian Cancer Research Institute, Bombay)

ing to this concept, sex determination in humans depends upon the structure of sex chromosomes in the fertilizing spermatozoon, and not on the nuclear structure of the ovum. After the sex is determined by the chromosomal mechanism, the unravelling of the anatomical sex is done by the process of sex differentiation which has two phases: (i) differentiation of the gonads, and (ii) differentiation of the accessory sex organs. Normally, an orderly sequence of changes brings about the transformation of a bisexual embryo

to either male or female in accordance with the genetic sex (Fig. 3).

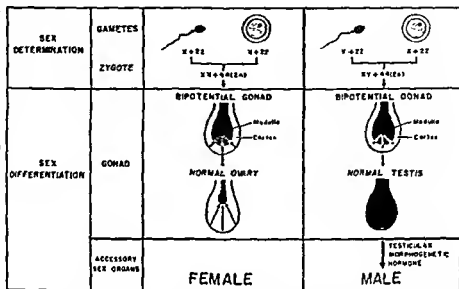


Fig. 3. Diagrammatic scheme of human sex determination and differentiation. (Courtesy: Dr. P. N. Shah, Indian Cancer Research Institute, Bombay).

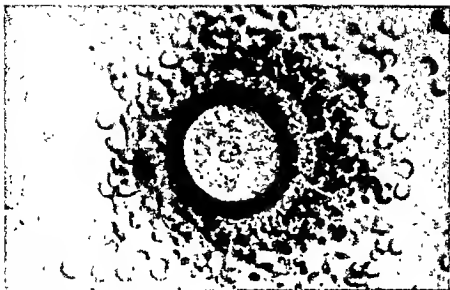
The first gonadal primordium that appears round about 5-6 weeks of embryonic life irrespective of the genetic sex of the embryo has two major components, viz. the outer cortex and the inner medulla.

Diagnosis of Sex of Foetus during Pregnancy. The underlying principle is the study of sex chromatin pattern in the nuclei of skin cells of the foetus shed in the liquor amnii. The characteristic sex chromatin pattern gives the clue to the sex of the foetus (Plate 5).

Liquor amnii is obtained by paracentesis uteri. A wide-bore lumbar puncture needle is used for the paracentesis, after infiltrating the abdominal wall with novocaine. About 5 ml. of the collected fluid is centrifuged and the supernatant fluid is poured off.

One hundred well stained nuclei are counted, while the rest of the poorly stained, badly fragmented or markedly pyknotic nuclei are omitted.

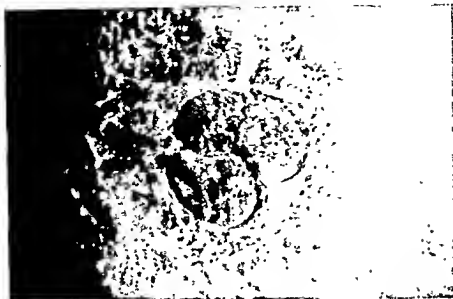
From a study of 138 samples of amniotic fluid obtained from patients admitted to N.W.M. Hospital, Bombay, done by Rami et al the results were as follows: Forty seven samples were not suitable for study because of the insufficient number of nuclei for prediction



Pl-6 Human ovum before fertilization in vitro with the attached granulosa cells (p. 17)



Pl-7 Human fertilized ovum in vitro, two-cell stage (p. 17).



Pl-8. Parthogenetic human ovum, three-cell stage (cultivated follicular ovum) (p. 17).



Pl-9. Human ovum in vitro, eight-cell stage. (p. 17).



Pl 10. Human ovum *in vitro*, morula stage. (p. 17).

(Plates 6 to 10). *Courtesy Prof. Motoyuki Hayashi, Toho University, School of Medicine, Tokyo.*

CHAPTER 3

EARLY DEVELOPMENT OF OVUM AND PLACENTATION

Immediately following fertilization, there is formed around the ovum a thick membrane, the *zona pellucida*. The formation of *zona pellucida* has been known to occur in other animals, but is confirmed as occurring in the human embryo by the recent works of Hertig and Rock. This tough translucent membrane prevents the young embryo during its transit to the uterus, from having any direct cell-to-cell contact with the epithelium (Plate 6).

Transport of Fertilized Ovum into Uterine Cavity

It seems probable that the human ovum takes from 3 to 5 days to pass through the tube. The exact mechanism of its propulsion along the tube is not known but, most probably, the muscular contractions of the tube, which are known to be increased about the time of ovulation, are largely responsible—with the cilia of the epithelium assisting in the process.

The time of arrival of the embryo in the uterine cavity would be about 16 to 18 days after the beginning of the preceding menstrual period. At this time of the menstrual cycle, known as the secretory phase of the endometrium, the endometrium has become thick and spongy with tortuous secretory glands and is favourable for the reception of the young embryo.

During its transit through the tube, the ovum is undergoing division, and by the time it arrives in the uterine cavity, it has become a solid spherical mass of small cells. This is known as the *morula* stage (Plates 7, 8, 9, 10). For about a period of 2 or 3 days after its arrival in the uterine cavity, the embryo is still encased in the *zona pellucida*, and therefore remains unattached to the endometrium. It seems probable that during this period the young embryo is nourished by the glycogen-containing secretion of the active uterine glands. From circumstantial evidence of the changes in other mammalian embryos during this short period before implantation, it is probable that in the human embryo also, hollowing out of the *morula* occurs. The embryo now has a central cavity

which is lined by a layer of cells, the future trophoblastic layer. All the other cells are concentrated at one pole and this group of cells are known as the inner cell mass. At this stage the ovum is known as a *blastocyst* or *blastodermic vesicle*. The zona pellucida now disintegrates, thus preparing the embryo for implantation (Plate 11).

Embedding of Ovum

The trophoblastic cells of the living blastodermic vesicle of the monkey are noticeably sticky, particularly those overlying the inner cell mass; and it is this property of the cells that makes the blastodermic vesicle adhere by this part of its surface to the endometrium. Almost as soon as adhesion occurs, the trophoblastic cells begin to proliferate rapidly and erode the underlying uterine mucosa. In the seven-day embryo recovered by Hertig and Rock, the cells of the blastodermic vesicle overlying the inner cell mass were, as in the case of the monkey, the first to adhere to the uterine mucosa (Plate 12). The trophoblastic cells in contact with the uterine mucosa, rapidly become large and dark-staining, in contrast to the thin trophoblastic cells of the unburied cells of the vesicle. As these trophoblastic cells in contact with the uterine mucosa enlarge, they lose their cell boundaries, and thus the trophoblastic syncytium is formed. Once the syncytium is formed, it burrows into the maternal tissues, and the embryo becomes buried in the mucosa. An embryo, eight days' old, becomes almost completely embedded in the mucosa. By the ninth day, the surface epithelium of the endometrium covers the area through which the embryo had eroded its way.

The trophoblast progressively invades the maternal tissues, and an increasing number of sinusoids and glands are opened. During this phase of activity of the trophoblast, the embryo itself grows relatively slowly. Until the trophoblast is able to make effective metabolic interchange with the maternal circulation, the *growth of the embryo is naturally slow*.

Once the embryo is implanted, rapid and profound changes occur in both, the endometrium and the chorion.

Changes in Endometrium

The conditions encountered by the embryo in the endometrium at the time of implantation need consideration at this stage.

If the average time of ovulation is taken as the thirteenth or the fourteenth day of a twenty eight day menstrual cycle, and the presumable age of the embryo is about seven days when implantation occurs, then the pattern of the endometrium would be that obtained at the twentieth or the twenty first day of the cycle. The endometrium at this stage of the cycle is in a full secretory stage. The secretion from the tortuous endometrial glands, together with the material produced as a result of the proteolytic activity of the trophoblastic syncytium in its invasion of the endometrium, contribute a fluid which bathes the trophoblast. It is probable that this fluid is utilized in the nourishment of the embryo until such time as when an efficient mechanism of vascular interchange develops. This liquid is commonly known as "*embryotroph*".

The condition and arrangement of the maternal vessels in the endometrium at the time of implantation is equally important. During the menstrual cycle, the spiral arteries undergo conspicuous changes. In the first half of the cycle, they are less coiled and extend only upto the deeper half of the endometrium. Following ovulation and during the active phase of the corpus luteum, they become markedly coiled, and extend upto the surface of the endometrium. Therefore, by the time the ovum is ready for implantation, there is a rich supply of blood in the endometrium (Fig. 4).

Decidua. After the first week, the endometrium becomes thicker and decidual cells form. This altered endometrium during pregnancy is known as decidua. At the end of the tenth week, the decidua reaches its greatest development. It is as thick as 1 cm. on the anterior and posterior walls, and less thick at the sides of the uterus and at the fundus. Examination of the decidua cast off at abortion shows its inner surface thrown into deep but smooth folds, and the outer surface to be fluffy.

For the purpose of description, the decidua is divided into three portions. That lining the main cavity of the uterus is known as the *decidua vera*; that beneath the ovum is termed the *decidua basalis* (*serotina*), and it is in this portion that the placenta is formed. The portion which surrounds the rest of the ovum is known as the *decidua capsularis* or the *decidua reflexa* (Fig. 5).

Decidua Vera. Microscopically, the decidua vera, from the surface inwards, shows four distinct patterns:

- (1) The surface epithelium is tall and thin except around the openings of the glands.

- (2) The *decidua compacta*, which constitutes nearly one half



Fig 4. Diagram showing the configuration of the spiral arteries in the endometrium of the Rhesus monkey. A. From an endometrium associated with a corpus luteum of about 7 days. B. From edometrium associated with 10-11 day corpus luteum. C. From endometrium associated with a mature corpus luteum. Note the greater conspicuousness of the spiral arteries at this stage, their extension close to the surface, and the striking richness of their small superficial branches. (After Bartelmez. Courtesy: Modern Trends in Gyn. & Obst., Int. Cong. of Gyn. & Obst., 1953. Librairie Beauchemin Limitée, Montreal, Tome 1).

of the whole thickness, is composed of decidual cells packed together with fibrillary stroma. The decidual cells are large, ovoid or spindle-shaped, contain much protoplasm.

(3) The *decidua spongiosa* is composed of elongated, convo-

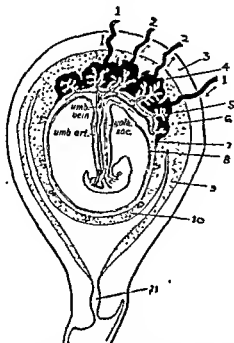


Fig. 5. Diagrammatic representation of amnion, chorion and decidua in the third month and the formation of placenta.

luted uterine glands. The cells of the glands are low, pale-staining, and actively secretory. The interglandular septa are thin so that an intricate lacy pattern is produced.

(4) The basal layer is a small unaltered layer in which the glands are straight, and lined by cuboidal non-secretory type of epithelium.

After the third month, the decidua vera thins out and, at term, it is hardly 1 mm. in thickness. The decidua compacta, which during the early weeks formed half the thickness, is reduced to a narrow strip, and most of the decidual and stromal cells are in a state of coagulating necrosis. The decidua spongiosa contains glands in the deepest part. From the remnants of these glands, the new endometrium is formed after delivery.

Decidua Capsularis or Reflera. The implanted ovum grows towards the uterine cavity. After its entry into the uterus, it is covered by a thin layer of decidua which, so to say, forms a capsule around the ovum, and shuts off the ovum from the rest of the uterine cavity. It is, for this reason, called decidua capsularis. During the early months of pregnancy, there is a space in the uterine cavity between the decidua vera and the decidua capsularis, known

as chorio-decidual space (Plate 13). As the ovum grows, the space becomes narrower and at the end of the 3rd month the growing ovum entirely fills the uterine cavity. As a result, the decidua capsularis fuses with the decidua vera, and the space between the two is obliterated.

The decidua capsularis is well developed in the second month. Histological examination at this time shows that it is made up of decidual cells, and is covered on the outside by a single layer of flattened epithelial cells. On the inner side, it is in contact with the chorionic villi. There are no traces of uterine glands in the decidua capsularis.

Decidua Basalis. It is that portion of the decidua where the placenta is formed. Structurally, it differs from the decidua basalis in two respects. First, the spongiosa is vascular and is mainly composed of arteries and widely dilated veins. Second, it is invaded by trophoblastic giant cells. These giant cells vary in number, and may penetrate into the muscularis.

Changes in Chorion

The trophoblast cells from which the chorionic villi are developed, as described above, lose their cell boundaries. The syncytium grows peripherally as clusters without any arrangement. These trophoblastic projections are at this early stage without mesenchymal core, and are commonly referred to as *primitive* or *primary villi*.

Towards the end of the second week of embryonic growth, the trophoblast begins to be moulded into masses more suggestive of villi. The cell masses now begin to show two types of cells. The outer layer without cell boundaries are merely masses of protoplasm containing multiple scattered nuclei called the syncytiotrophoblast (plasmoditrophoblast). The deeper-lying cells are small cells with distinct cell boundaries known as cytotrophoblast, or Langan's cells. Within a short period, ingrowth of allantoic vessels and mesoderm appears on the inner surface of the blastodermic vesicle. Early in the third week after fertilization, the mesoderm pushes into the primitive villi, and blood vessels soon appear in the connective tissue core of the mesoderm. A villus now consists of a central mesodermic core in which are branching blood vessels. Covering this mesodermic projection are the two trophoblastic layers, the Langan's cells and the syncytio-

trophoblast. This is now a "true" villus (Plate 14). The villi so formed retain the same general structural plan throughout pregnancy, although, as pregnancy advances, their connective tissue core and blood vessels become more highly developed, and there are marked regressive changes in their epithelial lining.

In some of the villi, the trophoblast over the tips disappears and the mesodermal connective tissue at the distal end of the villi becomes adherent to the endometrial connective tissue. These adherent villi are known as *anchoring villi*. The majority of the villi lie free and continue to float in the pool of maternal blood in the excavated areas, and are known as 'floating' villi (Plate 15).

Once the chorion has been well established in the uterus, the invasive process becomes slower, merely keeping pace with the growing embryo. The invasive structure of the syncytiotrophoblast is replaced by its forming a more regularly arranged covering outside the cytotrophoblast layer of the villus.

The mesenchymal core of the villus becomes organized into a delicate connective tissue supporting the epithelial walls of the blood vessels. Scattered in the tissue, there appear varying numbers of cells, conspicuously larger than the ordinary connective tissue cells, known as *Hofbauer cells*. Their significance is not definitely understood, but they appear to have a phagocytic action.

The cytotrophoblastic layer, known as Langhan's cells, reaches the height of its development during the second month. Thereafter, it gradually loses its completeness. During the fourth and the fifth months, the cytotrophoblast layer undergoes still further regression. Most of the villi come to be clothed in a reduced syncytiotrophoblast layer with only occasional cytotrophoblastic cells persisting. During the last trimester of gestation, this process becomes more marked, but the villi do not become as completely denuded of epithelium as was formerly believed (Plate 16).

In the first six to eight weeks, the ovum is covered all round by the chorionic villi (Plate 17). The chorionic villi covered by the decidua capsularis and surrounding the ovum are known as chorion laeve. The decidua capsularis thins out after the eighth week, and the chorionic villi in this region find little nourishment and soon undergo atrophy (Plate 18). At the end of the tenth week of development, the chorion laeve disappear entirely.

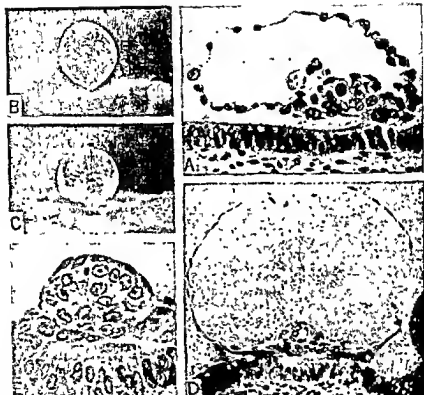
In the region of the decidua basalis, the trophoblast breaks down many small maternal blood vessels, and there is extravasa-

tion of blood. The trophoblast is known to produce some substance which inhibits the coagulation of blood. There is also transudation from the neighbouring intact vessels. The villi thus bathe in a pool of blood and lymph.

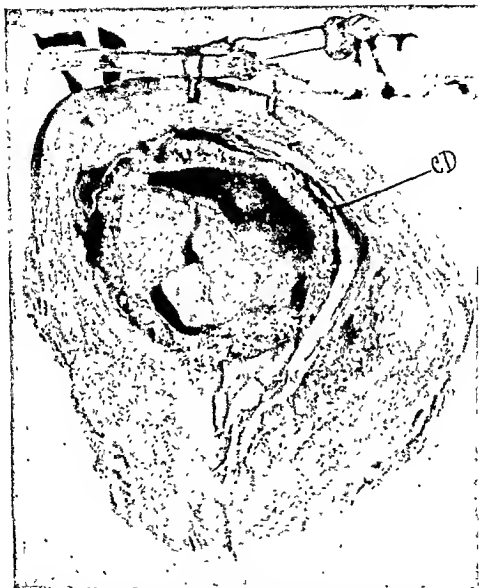
Intervillous Space. Shortly after implantation, tiny lacunae arise in the solid trophoblastic wall of the ovum. They soon coalesce and, within a few days, blood from the capillaries and venules invaded by the trophoblast, begins to seep into them. Later, with further invasion by the trophoblast, maternal blood from the tips of the spiral arterioles commences actively to circulate through the lacunae. The villi begin to invaginate the blood-filled space, which now has become a single pool.



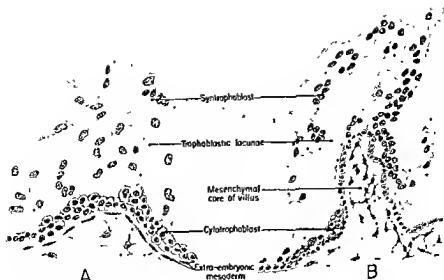
Pl-11. Photomicrograph ($\times 600$) of a human blastodermic vesicle recovered from the uterus. Note that this embryo, of about 6 days fertilization age, has lost its zona pellucida and is, therefore, ready for implantation (p. 18).



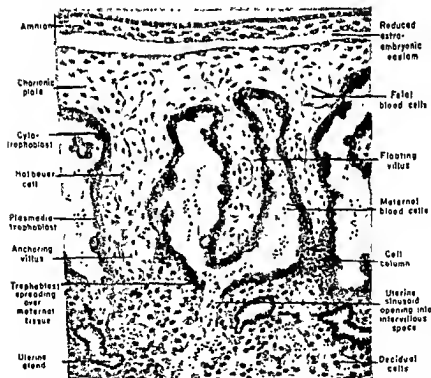
Pl-12 Photomicrograph showing stages leading up to implantation of monkey embryo. A Section ($\times 350$) of embryo of ninth day showing initial adhesion to uterine epithelium B. A nine-day embryo attached to uterine mucosa, viewed from above, $\times 50$ C Same embryo photographed from the side, $\times 50$. D Same embryo shown in B and C after sectioning, photomicrograph $\times 200$. E. Embryonic area of the same embryo, photomicrograph $\times 500$ (p. 18).



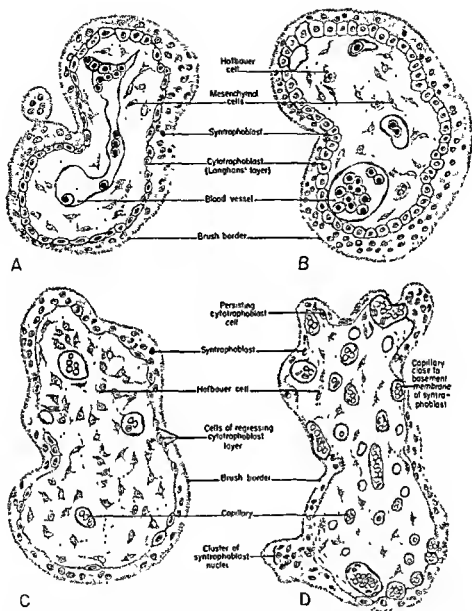
Pl-13. Specimen of uterus with an early ovum in situ. C.D. chorio-decidual space. (Courtesy: N. W. M. Hospital Museum, Bombay) (p. 22).



Pl-14 Early stages in development of chorionic villi. A. Primitive trophoblastic projection without mesenchymal core. B Young villus just developing a mesenchymal core (p. 23).



Pl-15. Semischematic drawing to show the relations of the chorionic villi and the trophoblast to the maternal tissues of the placenta (p. 23).



Pl-16. Chorionic villi at various ages. **A.** From chorion of four-week embryo (C-R 4.5 mm.). **B.** Chorion from an embryo of about six and a half weeks (C-R 15.1 mm.). **C.** Placenta from a foetus of the fourteenth week. **D.** Placenta at term. From preparation loaned by Dr. Burton L. Baker. (p. 23).



Pl-17 Specimen of ovum of eight weeks; the chorionic villi completely surround the ovum (p 23).



Pl-18 Specimen of twin-pregnancy ovum of five weeks, the chorionic villi partially surround the ovum (p. 23).

(Plates 17, 18. *Courtesy N W M Hospital Museum, Bombay*)



19-19) A Mature placenta of the dispersed variety. It will be seen that the foetal arteries divide rapidly into a series of divisions which cover the entire foetal placental surface B In contrast to A, this is an example of magisterial or cluster placenta. The primary arterial divisions show relatively few divisions and to the end of their course remain relatively large vessels. Many placentas show features intermediate between the dispersed and magisterial varieties J M Crawford (Courtesy: *Amer. Jour. of Obst. & Gyn.*, supplement to the December 1, 1962, issue. Published by C. V. Mosby & Co., St. Louis, Missouri) (p 26)

CHAPTER 4

VASCULAR ANATOMY OF HUMAN PLACENTA

Mossman regarded an animal placenta as an intimate apposition or fusion of the placental organs with the maternal tissues for physiologic exchange. Crawford defines the human placenta as "an intimate presentation of the foetal capillary bed to maternal tissue. The presentation is extra-corporeal and, at first, diffuse but, after the twelfth week of pregnancy, it becomes restricted to one area where it forms the 'definite' placenta".

Crawford aptly states that the human placenta provides a paradox since it is one of the most readily available structure for examination and yet it is one of the least known. The histological studies of the placenta have been worked out in detail by many workers in the field. The gross anatomy of the placenta has been studied by Spanner and others by injection corrosion method—a technique by which the foetal blood vessels are filled with a suitable material, such as liquid latex, or a plastic, such as vinyl acetate. Recently, Crawford has evolved a new technique for studying the gross anatomy of the placenta. Most of his observations have been summarised in this section.

Foetal Surface of Placenta. The foetal surface of the placenta is covered by the amnion beneath which is the chorion. The umbilical blood vessels enter the foetal surface of the placenta and, for the remainder of the course, are firmly bound by the chorion. The blood vessels are seldom centrally inserted into the placenta. The eccentric insertion is very variable. When the blood vessels are attached laterally to the margin, it is known as a *battledore* placenta. When the umbilical vessels have a considerable free length on the foetal surface of the chorion before reaching the placenta, it is known as *velamentous* insertion of the cord.

The arteries are usually of equal size and each supplies one half of the placenta; but there are variations and one artery may be smaller and the area supplied by it considerably less. Sometimes, one artery may traverse beyond the free margin of the placenta and finally end in an extra or *sucenturiate* lobe. It is noteworthy, as commented by Spanner, Crawford and others, that

howsoever the blood vessels may divide, they are unique in the body by always lying in one plane.

The pattern of division of each artery after its insertion varies in different placentae and falls into two types. Schordania has termed them as *dispersed and magistral* (Plate 19).

In the dispersed type, each umbilical artery begins to divide immediately after its insertion into the chorion. Each artery divides and redivides into vessels of gradually diminishing calibre. In the magistral variety, the two arteries extend almost as far as the margin of the placenta before their calibre diminishes. Along their course, each artery gives off small branches. At each division of the umbilical arteries, a proportion of them are seen to perforate the chorion and enter the substance of the placenta. Branches which directly enter the substance of the placenta are also given off from the undersurface of the arteries. These branches are not directly visible but are seen when the chorion is lifted up and its external surface is inspected.

The umbilical vein also undergoes a parallel division corresponding to that of the umbilical arteries and accompanies the arterial branches and, its branches like the arterial branches, perforate the chorion and enter the substance of the placenta. All the arterial branches in the substance of the placenta are accompanied by veins. All the arterial divisions, however small, end with their accompanying veins within the placenta in cotyledons.

Maternal Surface of Placenta. As the word cotyledon is intimately connected with the description of the maternal surface of the placenta, its definition is important. Currently, the word cotyledon is applied for two entirely separate purposes. The *maternal cotyledon* is the portion of the placenta lying between the two complete septa running from decidua to chorion. The *foetal cotyledon* represents the terminal portions of the foetal circulation.

About 10 to 15 round or oval *maternal cotyledons, lobes*, are seen on examination of the maternal surface of the placenta (Plates 20, 21).

On an average, there are some 200 *foetal cotyledons* in each placenta and, of these, 10 to 15 are of large size, about 50 are of medium size, and the remaining are small. The large and medium foetal cotyledons form the bulk of the placenta. A foetal cotyledon is the terminal capillary bed of an artery and a vein. The branches of the umbilical arteries and its accompanying veins, after perforating the chorion, course for a variable distance, downwards or

laterally, in the substance of the placenta and finally end in a capillary bed, a cotyledon. Before each primary vessel ends in a terminal cotyledon, it gives off several lateral branches which may again divide and subdivide, but always terminate in a capillary bed, a cotyledon. It is thus evident that the size of the capillary bed (cotyledon) is related to the size of the vessel. It should be noted that there is no arterio-venous anastomosis of the capillary beds as is the case in other parts of the body.

On separation of the lobes, the underlying maternal surface of the chorion is visible. When the chorion is lifted upwards, the branches of the umbilical vessels can be seen perforating the chorion and passing downwards to form cotyledons (Plate 22). It will be seen that there are large "bare areas" in the chorion which are quite devoid of vessels. In utero, however, these apparent bare areas are occupied by the adjacent cotyledons which, being filled with maternal blood, are tense, pulsatile structures.

Anchoring of Placenta. The placenta is fixed to the uterus by the peripheral divisions of those cotyledons which reach the decidua. A portion of the fixing trunks inserted into the decidua either end vertically in the decidua or, after entering the decidua, travel horizontally for a short distance and then curve upward and end in capillary structures. These intradecidual foetal vessels are often surrounded by fibrin and even exhibit endarteritic change, sometimes amounting to complete closure of the artery and vein. This is particularly noticeable on those divisions which are inserted around the periphery of the placenta. The position of the intradecidual portions of the vascular trunks is often indicated by the circumscribed white areas of fibrin—white infarcts—seen on the maternal surface. These so-called white infarcts are commonly found in postmature placentae of women having severe pre-eclampsia. As the placental vascular reserve is considerable, foetal distress during labour does not occur, unless the areas affected are either of considerable size or number.

Growth Changes of Placenta during Pregnancy. During pregnancy, the placenta steadily increases in size and weight. The weight of the digested placenta, that is after removal of maternal blood, fibrin and decidua, has been studied by Crawford. At 12 weeks, the weight is 13 grams; it increases to 200 grams at term. He found that the total number of cotyledons is the same at 12 weeks as at term. The increase in weight is entirely due to increased growth of each cotyledon (Plate 23). For example, a cotyledon

weighing 1.0 gram and measuring 2 cm. in length at 12 weeks' maturity can be contrasted with a cotyledon weighing 7.0 grams and measuring 4.0 cm. in length at 40 weeks. The increase in the size of the cotyledon is reflected in the diameter of the foetal vessels. A primary division on the foetal surface of the chorion at 12 weeks' maturity might have a diameter of 0.28 mm., while at 40 weeks a corresponding division would have a diameter of 5.0 mm. The increase in volume is well summarised by Crawford: "If each cotyledon could be regarded as a vascular cylinder of known length (of main cotyledonary artery) it is possible to calculate, in a theoretical fashion, its increase in volume from 12 to 40 weeks. It has been shown that the volume of such a cotyledon will increase by 500 times".

Maternal Circulation within Intervillous Space. In the past, highly elaborate theories had been advanced for understanding the placental circulation, but with improvements in investigation technique these theories have been rejected. The early investigators based their theories on the concept that there must be anatomic separation of the arterial blood from the venous return, so that short-circuiting does not occur and the blood is allowed to remain in contact with the capillary villous bed, sufficiently long for exchange to take place.

At the end of the nineteenth century, Bumm described the entries of the maternal arteries to the intervillous space as located high up on the maternal septa. According to this view, the blood entered the intervillous space close to the subchorial lake and then flowed back towards the venous sinuses in the decidual plate, bathing the villi on its way back. In 1935, Spanner, by improved injection technique, conclusively demonstrated that the spiral arteries opened in the decidual plate but not high up in the maternal septa as Bumm had described. The maternal blood was directed upwards to the chorion by the overflow, thus bathing the villi on the way. Spanner was, however, unable to distinguish venous orifices on the basal plate with any regularity. He postulated that the arterial blood, after reaching the chorion, passed laterally to the periphery of the placenta where it was drained away by peripheral maternal veins. These veins formed a continuous ring around the placenta which he called the *marginal sinus*. This concept of the maternal placental circulation, in view of recent work, is unacceptable.

With modern developments and improvements in the injection technique, the passage of radio-opaque dyes into the placenta

has been studied by radioangiography in the monkeys by Ramsey and others and in the human by Borell, Marais and others. According to their observations, the arterial inflow of the placenta is derived from the spiral arterioles or their branches. The spiral arteries lie more or less perpendicular to the uterine wall. The branches of the spiral arterioles supply mainly the decidua, though an occasional one enters the intervillous space. Spanner, Boyd and Marais are the only workers who have attempted counts or estimates of the number of vascular connections in the human placenta. Spanner reported 500 arteries at term; Boyd 180 to 320, but he considers the figures too high. Marais found the largest number of spiral arterioles as 105. The spiral arterioles, after piercing the basal plate, have one or many openings into the intervillous space, and are indiscriminately scattered over the basal plate. Arterial blood spurts in jets from the openings of the spiral arterioles and is driven high up towards the chorionic plate by the maternal arterial pressure before lateral dispersion occurs. The head of the pressure which thus drives the blood toward the chorionic plate prevents lateral dispersion of the blood and short-circuiting into adjacent venous orifices before it has circulated through the intervillous space. The height to which the arterial blood rises in the intervillous space depends on the size of the arteriole, the depth and inclination of entry, and the density of the branching villi in the path of its flow. Thus, some arterioles supply a small area around their openings, while others supply a large area extending high up towards the chorion in the villous free area. After bathing the villi, the blood returns back towards the basal plate. Ramsey is of the view that the maternal circulation is maintained by the pressure differences between the arterial and venous blood. Ramsey has shown that while the arterioles are situated perpendicular to the uterine wall, the veins run parallel to it. This anatomical arrangement allows closure of the veins during uterine contraction, thus allowing sufficient time for exchange to take place. The flow of the incoming arterial blood is also slowed down by the swaying arborescent villi in the intervillous space.

The rate and volume of the maternal blood flow in the intervillous space has been studied by injection of radioactive substances. The total uterine flow in the human placenta at term has been estimated by several workers: Flexner, 50 c.c. per minute; Kayser, 250 c.c. per minute; Assali and Metcalfe, 500 to 700 c.c. per minute.

Foetal Circulation in Placenta. The foetal blood circulates to

and fro along the umbilical cord. There are two arteries and one vein encased in a *common sheath* of connective tissue. The umbilical vein carries the oxygenated blood from the placenta to the foetus, while the two arteries deliver the venous blood to the placenta. The blood flows from the vessels into the larger stem villi and from there into the vessels of the branching villi, becoming smaller and smaller until the terminal villi contain only a capillary network.

It was formerly believed that the maternal and the foetal circulation were entirely separate but, as a result of recent studies in A, B and O iso-immunization, it has become evident that foetal cells must be escaping into the maternal circulation through breaks in the 'placental barrier'.

As Patten states: "All the elaborate mechanism within the placental areas of vascular interchange would be of no avail if the blood of the embryo were not pumped through the chorionic villi by its developing heart". Most of the experimental work has been studied in the developing chick but, in spite of the many obvious differences between the chick and the human embryo, the basic structural plan of their young hearts is closely similar and the main vascular channels have readily comparable relations if looked at from a broad functional approach.

In all the higher vertebrates, there are two major extra-embryonic vascular routes. In birds and primitive mammals, both of these are equally well developed. One is the *vitelline arc* which goes to the yolk-sac for the absorption of the food stored in advance in the form of yolk, the other *extra embryonic arc* goes to the allantois. In birds and reptiles, this succular organ spreads out close beneath the porous shell through which the blood in this circuit receives oxygen and gives out carbon dioxide. But in the human embryo, the yolk-sac is virtually empty and the vitelline circulation to it is relatively small. On the other hand, the allantoic arc reaches its greatest development in mammals. In young mammalian embryos, it is the means of projecting embryonic vessels into the inner face of the chorionic vesicle, thereby bringing the embryonic blood sufficiently close to the uterine blood of the mother and permitting the necessary interchange of food, oxygen and waste materials. Instead of lying close beneath the shell, the small terminal vessels of the mammalian allantois are brought close to the interior of the uterus. This extra embryonic circuit is known as the umbilical circuit because the main vessels, supplying and

draining it, traverse the umbilical cord. Embryologically, it is the allantoic circuit (Plates 24, 25).

The body of the embryo lies open ventrally and, like all ventral structures, the heart at the time of its origin is a paired structure. As the embryo develops, the paired structures are brought closer by a folding process. When the embryo is complete ventrally, the paired primordia of the heart are brought together in the midline and fused.

No direct observations have been made on the beginning of the circulation of blood in the human but, by reasoning from the conditions known to exist in other embryos, it appears that the first heart beats of the human embryo occur at about the transition from the third to the fourth week of development.

Whether it be the chick within its egg shell or a human embryo in the uterus, the blood must be pumped out of the embryonic body for acquisition of food and oxygen, and the elimination of waste materials. There is no other way of initiating metabolic interchanges in an embryo isolated from the outside world within its developing amnion and submerged in amniotic fluid. The placenta, therefore, must perform for the embryo the interchanges which in an adult are carried out by the lungs, the gastro-intestinal tract and the kidneys.

It has been suggested that there are regulatory devices, such as valves and complicated arterial and arterio venous anastomoses. Such regulatory mechanisms have not been confirmed in the placenta. Crawford rightly states that if one considers the length of the umbilical cord, 50 cm. or more, along which blood must travel in both directions, it is perhaps too much to ask a small foetal heart to overcome regulatory devices.

The maternal blood pressure in the intervillous space has been estimated at 10 to 15 mm. Hg. As against this, the pressure within the foetal capillary bed is about 30 mm. Hg and yet, against this pressure gradient, the placenta is able to absorb and excrete. The mechanism of transfer is therefore not by mere diffusion from one to the other side. The different modes of transfer for nutritive and other substances are discussed later.

Gross Vascular Anatomy

Umbilical Cord. The length of the umbilical cord is variable and may be as short as 10 cm. or as long as 150 cm., the average be-

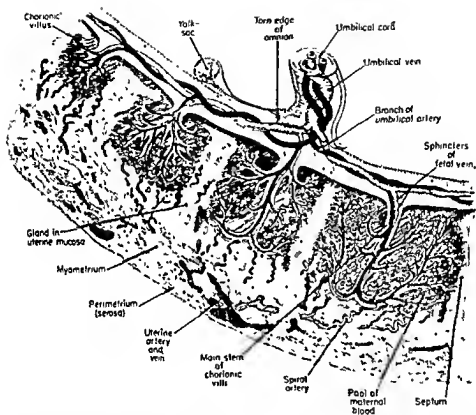
ing 50 to 60 cm. It extends from the umbilicus of the foetus to the foetal surface of the placenta. The cord is covered by a tubular sheath of the amnion which is closely adherent to it. The tubular amniotic sheath consists of a single layer of flattened cells, and is lined by the mesoderm which gradually acquires jelly-like properties and becomes Wharton's jelly. At first, the cord contains embryonic structures including a right umbilical artery, the allantois and an extra embryonic coelom. These, however, disappear, leaving only one umbilical vein and two umbilical arteries (Plate 26). The umbilical arteries are the main continuation vessels of the foetal internal iliac arteries. The umbilical vein ends within the foetal abdomen when it joins the ductus venosus.

The cord presents a spiral appearance, the coiling usually being from left to right. As the vessels are usually longer than the tubular amniotic sheath, they are frequently folded upon themselves at places, giving a nodular appearance to the surface, the false knots. Occasionally, a true knot is formed by the foetus slipping through a loop of the cord. This is likely to occur when the cord is very long or while performing an external version. This does not necessarily cause foetal death by arresting the circulation through the cord (Plate 27).

The arteries have a much smaller lumen than the veins. The arteries and veins have considerable muscle fibres in their walls, the arteries having a thicker wall than the veins. Some of the muscle fibres have a circular course and this gives constricted and dilated areas to both arteries and veins, and are known as Hoboken's valves. Whether these have any functional significance or are produced after delivery is not clear. It is not possible to examine the appearance of the cord in utero. It is likely that, after delivery, circular muscle fibres are stimulated by handling of the cord or as a result of the increased oxygenation of the foetal blood and present this nodular appearance.

The two umbilical arteries are usually joined by a single anastomotic branch of varying length just before they are inserted into the placenta. This is considered to be the only anastomosis to be found in the placenta and is known as Hyrtl's anastomosis. The main function of this anastomosis appears to be an equalisation of arterial pressure in each half of the placenta supplied by the respective arteries.

It is noteworthy that the venous pressure in the cord is maintained at a surprisingly high level of 30 to 40 mm. Hg in spite of



Pl-20. Schematic diagram to show the interrelations of foetal and maternal tissues in the formation of the placenta. The chorionic villi are represented as becoming progressively further developed, from left to right across illustration. Foetal arteries are represented in black and foetal veins with line shading. Maternal arterial channels are shown in heavy diagonal hatching and maternal veins in a similar scheme but lighter (p. 26).

VI A 3



Pl-21 Maternal surface of placenta C, cotyledons. (Courtesy: N. W. M. Hospital Museum, Bombay) (p. 26)

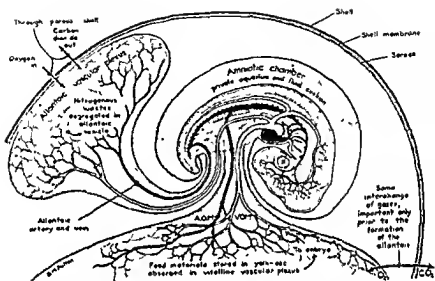


Pl-22. The chorion has been reflected upward and the trunks of the cotyledons can be seen emerging from the chorion and passing downward to form cotyledons. J. M. Crawford (p. 27).

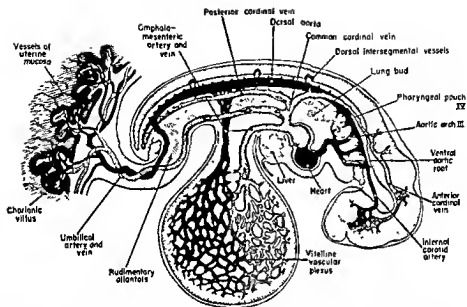


Pl-23. The cotyledons of 12, 16 and 20 weeks' maturity shown (left to right). They have been removed from a digested placenta but are otherwise intact. The gradual increase in size with increasing maturity is apparent. J. M. Crawford (p. 27).

(Plates 22, 23. Courtesy: *Jour. Obst. & Gyn. Brit. Comm.*; 62: 896, 1955; and 66: 885, 1959).

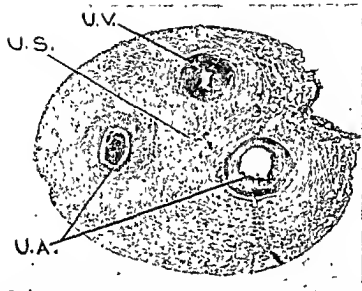


Pl-24 Schematic diagram showing arrangement of main circulatory channels in a young chick embryo. The sites of some of the extraembryonic interchanges important in its bio-economics are indicated by the labelling. The vessels within the embryo carry food and oxygen to all its growing tissues, and relieve them of its waste products incident to their metabolism. A.O.M., omphalomesenteric artery; V.O.M., omphalomesenteric vein (p. 31).

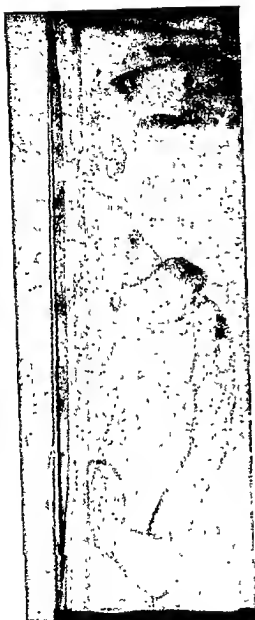


Pl-25. Schematic drawing showing the arrangement of the main circulatory channels in a young mammalian embryo. Notice how clearly comparable the vascular plan of the mammalian embryo is to that of the chick in Plate 24 (p. 31).

(Plates 11, 12, 14, 15, 16, 20, 24, 25. Courtesy: *Modern Trends in Gyn. and Obst., Int. Cong of Gyn & Obst., 1958. Librairie Beauchemin Limitee Montreal. Tome I).*



Pl-25. Photomicrograph, section of umbilical cord U. V., umbilical vein
U.S., umbilical stalk, U.A., umbilical artery (p. 32).



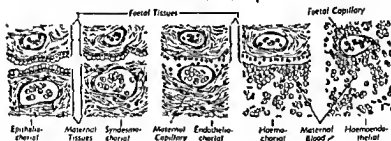
A



B

Pl-27. Umbilical cord showing (A) true, and (B) false knots. (Courtesy: N. W. M. Hospital Museum, Bombay) (p. 32).

Groups	Tissues Separating Maternal and Foetal Blood						Gross Form of Placenta	Typical Examples
	Maternal Tissue Overlying Membrane				Foetal Chorion			
	Endothelium	Connective Tissue	Epithelium		Epithelium	Connective Tissue	Epithelium	
PI epithelio-chorialis	+	+	+		+	+	+	diffuse Fig. Horse
PI Syndesmo-chorialis	+	+	—		+	+	+	multiplex Ruminants
PI endothelio-chorialis	+	—	—		+	+	+	zonary carnivora
PI Haemo-chorialis	—	—	—		+	+	+	discoid rodents insectivores Bats Mice Apes Man



Pl-28. Above, a tabulation and, below, a diagrammatic sketch illustrating the Grosser classification of placentas upon the basis of the tissue layer separating maternal and foetal blood. The fifth category in the sketch, the hemo-endothelial type, was added by Mossman (From Ambroso, Elizabeth Ramsey. Courtesy: *Amer. Jour. Obst. & Gyn.*, Vol 84, No. II, Part 2, 1962 (p. 43))

there being no advantage of gravity, muscular contraction or foetal respiratory movement. It is suggested that the venous pressure is maintained at this high level by the rhythmic contractions of the umbilical arteries which surround the vein in a spiral manner.

Development of Foetus At Different Periods of Gestation

End of First Month. The embryo is about 1 cm. long and weighs about 1 gram. The embryo is doubled on itself so that the head and the tail almost touch. The yolk-sac is still present and the cord is short and thick. The rudiments of the eyes, ears and nose are visible, and the buds corresponding to the limbs are distinct.

End of Second Month. The embryo is 2.5 to 3 cm. long and weighs about 4 grams. Owing to the development of the brain, the head is disproportionately large. The hands and feet begin to appear. The external genitalia are seen but sex is not differentiated in them. Most of the chorionic villi surrounding the ovum have disappeared.

End of Third Month. The foetus is about 8 cm. long and weighs 30 grams. There is beginning of sex differentiation. The centres of ossification have appeared in most of the bones. The fingers and toes can be seen and are supplied with nails.

End of Fourth Month. The foetus is about 16 cm. long and weighs about 100 grams. The sex is now distinctly differentiated. Lanugo has appeared on the skin. The cord is seen and exhibits twisting. The decidua capsularis has fused with the decidua vera and the placenta is well formed.

End of Fifth Month. The foetus is about 25 cm. long and weighs about 300 grams (8 to 10 ounces). The skin is covered with vernix caseosa. A few hair appear on the head. The child, if born alive, may live for 5 to 10 minutes, with strong heart beats.

End of Sixth Month. The foetus is about 30 cm. long and weighs about 680 grams (1½ pounds). The eyebrows and eyelashes are formed. The nails are distinct. Such a foetus may live for several hours. Since its respiratory, digestive and assimilatory organs are underdeveloped, such a foetus cannot be reared by artificial means.

End of Seventh Month. The foetus is about 35 cm. long and weighs about 1100 grams (2½ pounds). The eyes are opened. The testicles have descended into the scrotum. The child has a feeble

cry, makes vigorous movements but seldom survives as the lungs are not developed adequately.

End of Eighth Month. The child is about 40 cm. long and weighs about 1570 grams (3½ pounds). The skin is less wrinkled. The bones of the head are soft and flexible, ossification has begun in the lower epiphysis of the femur. Such children survive with proper nursing.

End of Ninth Month. The child is about 45 cm. long and weighs about 2500 grams (5½ pounds). The subcutaneous fat is more developed, and the wrinkles on the skin are smoothened out. The cartilage of the nose is distinct but the ears are still very soft. The circulatory, digestive and respiratory organs are well developed.

End of Tenth Month. The child is about 50 cm. long and weighs about 3200 grams (7 pounds). The child has hair on its head, and the nails project over the finger tips. The bladder contains urine, and the lower bowel is full of meconium. Its skin is pink, and the body is plump and well covered with fat.

Foetal Circulation

The essential difference between foetal circulation and that after birth is that in utero, during intrauterine life, the gaseous exchange and the material needed for the nutrition of the foetus are obtained across the placental barrier.

In utero, the foetus obtains its pure blood laden with nutritive material from the placenta by the umbilical vein which enters the body at the umbilicus. After penetrating the abdominal wall, the umbilical vein divides into two branches. The greater part of the purified blood goes along the larger of the two branches, known as the ductus venosus, which empties directly into the inferior vena cava. The smaller branch joins the portal vein and some of the blood passes along this, to supply the liver. The blood in the inferior vena cava above the hepatic vein, therefore, consists of impure blood returning from the lower limbs and the abdomen as well as the purified blood poured into it by the ductus venosus.

From the inferior vena cava the relatively pure blood enters the right auricle and is directed by the Eustachean valve, through the foramen ovale, into the left auricle. From there it enters the left ventricle and then it is pumped into aorta. Part goes to the head, neck and upper limbs. The rest is mixed with the blood coming from the ductus arteriosus and is carried downwards. Passing

down the aorta, some of the blood goes to the lower limbs and the body-wall, but the bulk of it passes into the iliac and the hypogastric arteries. The continuation of the hypogastric arteries in the umbilical cord is known as umbilical arteries and along these arteries, the impure blood reaches the placenta.

The impure blood returning from the head and neck returns by the superior vena cava to the right auricle. The blood from the inferior and the superior vena cava does not mix in the right auricle. That from the superior vena cava enters the pulmonary artery. As the lungs are non-functioning organs in utero, only a small part of blood goes into the lung for its nutritive needs; the bulk of the blood is short-circuited by another foetal structure, the ductus arteriosus, which connects the pulmonary artery with the descending aorta (Fig. 6).

From the above description it is evident that the head and the upper part of the body are supplied with much purer blood than the lower parts.

The distinctive features of the foetal circulation are the ductus venosus, the foramen ovale, the ductus arteriosus, and the hypogastric arteries.

With the first respiration of the newborn, a complete and sudden change from the foetal condition occurs as a result of which these distinctive vascular structures become functionless and are obliterated. With the onset of respiration, there is an expansion of the thoracic cage and the collapsed pulmonary vessels are opened up. The blood, which upto now passed through the ductus arteriosus directly into the aorta, is now directed to the lungs for oxygenation. The pulmonary arterial pressure falls considerably as resistance to the flow of blood in the pulmonary vascular tree is diminished.

As a result of the opening up of the pulmonary vascular bed, there is reduction in the return of blood flowing to the heart, and fall of general arterial pressure. Within a few minutes, however, there is adjustment of blood flowing back from the lungs into the heart and the level of the general arterial pressure is restored.

The ductus arteriosus closes down within a few minutes after birth because during foetal life the pressure in the pulmonary artery is high and the duct is kept distended all the time by the blood flowing through it. When the pulmonary circulation is initiated soon after birth, the blood from the lungs returns to the left side of the heart by the pulmonary veins and from there enters the

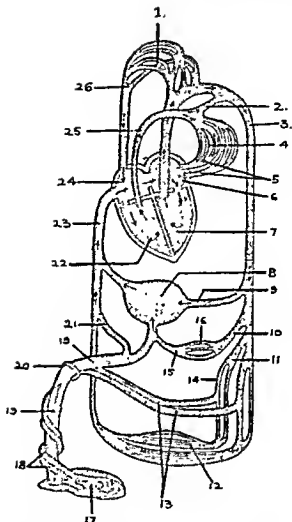


Fig. 6. Schematic representation of foetal circulation. 1, vessels of head and arms; 2, ductus arteriosus; 3, aorta; 4, vessels of the lungs; 5, pulmonary veins; 6, left auricle; 7, left ventricle; 8, liver; 9, hepatic artery; 10, mesenteric artery; 11, common iliac artery; 12, vessels going to legs; 13, hypogastric arteries; 14, internal iliac artery; 15, portal vein; 16, intestines; 17, placenta; 18, umbilical arteries; 19, umbilical vein; 20, umbilicus; 21, ductus venosus; 22, right ventricle; 23, inferior vena cava; 24, right auricle; 25, pulmonary artery; 26, superior vena cava.

aorta. As a result of the dual effect of the low pulmonary arterial pressure and the small amount of blood flowing through it, the ductus arteriosus is closed down by the contraction of the elastic and muscular tissues in its wall.

As soon as the circulation in the cord stops, the umbilical vein becomes functionless. Though no blood passes through it now, yet it remains a potential channel for 4-5 days. A replacement transfusion can be given to the newborn by passing a polyethylene catheter along it. In adult life, the fibrosed umbilical vein is known as ligamentum teres.

With the cessation of placental circulation, the blood flowing along the inferior vena cava into the right auricle is diminished and the tension in the right auricle is reduced. As a result, the Eustachean valve closes the foramen ovale within a few minutes after birth. A perfect anatomical fusion, however, takes time and is complete by the end of the first year after birth.

With the cessation of circulation in the cord, the hypogastric arteries become functionless. In adult life, the two obliterated hypogastric arteries are known as hypogastric ligaments and can be traced from the abdominal wall to the internal iliac arteries.

Amnion

Development. In the earliest stage, the amnion is a minute vesicle. Later, it covers only the ventral surface of the embryo and, eventually, it completely surrounds it. As pregnancy advances, it increases in size until its outer surface comes in contact with the inner surface of the chorion. The two membranes remain intimately connected throughout pregnancy. On an examination of the expelled placenta, the two membranes can be readily separated from one another.

Structure. The amnion consists of two layers. The inner layer consists of cuboidal cells. The outer layer is of mesoderm which becomes a mucoid like tissue devoid of blood vessels.

Amniotic Fluid

A certain amount of clear fluid is produced soon after the formation of the amniotic cavity.

Harrison and Malpas found a physiological hydramnios during the first 15 weeks of pregnancy, the conceptus occupying constantly about two thirds of the volume of liquor amnii. They consider this excess of liquor amnii as having a physiological function, providing a distension growth stimulus to the uterus in anticipation of the room required for the growing foetus. After the fifteenth

week, the foetus occupies a larger proportion of the uterine cavity and itself provides distension-growth stimulus to the uterus.

Composition. The specific gravity of liquor amnii ranges between 1007 and 1025. The reaction is alkaline. It consists of 9 per cent water and 2 per cent solids, half of which is organic and half inorganic. Early in pregnancy, the fluid has much the same composition as the maternal plasma. As term approaches, the fluid becomes hypotonic, but waste excretory products, such as urea, creatinine and lactic acid, increase in concentration.

Source of Liquor Amnii. The origin of liquor amnii is not known, but the possible sources are: (1) transudation from maternal plasma, (2) secretion by the amniotic epithelium, and (3) foetal urine. It is known that the amniotic epithelium has absorptive and secretory properties, and vacuoles have been found in the amniotic epithelium, suggesting its secretory function. The presence of urea proves that foetal urine forms some part of the volume of liquor amnii. A newly born foetus passes about 50 c.c. of urine in the first twenty four hours, and it is probable that roughly the same amount is contributed by the foetus in utero. Since the average volume of liquor amnii at term is about 700 ml., foetal urine, at best, forms not more than one-tenth of the normal volume of amniotic fluid. From this inconclusive evidence it is likely that liquor amnii is formed from all the three above-mentioned sources.

Vosburgh et al have determined, by Tracer techniques, the rate of renewal of water and sodium of the amniotic fluid in women and found that water was completely replaced every 3 hours and sodium one-fifth as slowly.

Diagnostic Uses of Liquor Amnii. (1) Sequeira elaborated a test at the N.W.M. Hospital for the diagnosis of vesicular mole by abdominal paracentesis. When the diagnosis of an undue enlargement of the uterus, as compared to the term of amenorrhoea, is in doubt, drawing of clear liquor excludes a vesicular mole. (2) Haemolytic disease of the newborn can be diagnosed by abdominal paracentesis. Walker could give a 95 per cent correct diagnosis from examination of the optical density of the liquor. The density is raised due to the presence of bilirubin, urobilinogen, in the liquor. (3) From the chromosome characteristics of the cells in the liquor the sex of the foetus can be determined by abdominal paracentesis. Rami et al were able to diagnose correctly 92 per cent of 132 cases tested in this manner at the N.W.M. Hospital. (4) *Amniography.* Localisation of the site of placenta by injecting

radio-opaque substances in the amniotic cavity, particularly for diagnosing a placenta praevia, is seldom employed nowadays for fear of precipitating premature labour.

Functions of Amniotic Fluid. (1) The foetus is protected from external shocks, and the liquor thus serves as a shock absorber.

(2) It provides a distension-growth stimulus to the uterus.

(3) The bag of fluid allows free growth and movement of the foetus. When there is marked oligohydramnios, the foetus is folded so much that the shortening of muscles occurs, or fibrous bands across different parts of the foetus are formed.

(4) During labour, it helps the early dilatation of the cervix by forming a hydrostatic wedge. The bag of water equalises the pressure exerted by the uterine contractions and, thus, prevents direct prolonged compression of the foetus.

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CHAPTER-5

FUNCTIONS OF PLACENTA

The two chief functions of the placenta are: (1) to produce hormones so as to maintain the conceptus from the time of embedding until full term. (2) to function as the foetal respiratory, digestive and excretory organ. These complex functions vary during pregnancy according to the demands of the foetus during its growth.

Hormonal Function of Placenta Protein Hormones

Human Chorionic Gonadotrophin. It is a glycoprotein having a molecular weight between 30,000 and 100,000 depending on the method of isolation. It is secreted soon after implantation and reaches peak levels between the second and the third months. By the fiftieth to seventieth day of gestation, the peak values of chorionic gonadotrophin excreted in the urine during 24 hours are 40,000 to 100,000 I.U. Thereafter, the values decrease over the next few weeks and are maintained at a constant level of 4,000 to 11,000 I.U. for the remainder of the pregnancy.

The peak of production and elimination of chorionic gonadotrophin corresponds with the growth and the decline of the cytotrophoblast (Langhan's cells) and suggests that the cytotrophoblast is the main source of production of this hormone. Histochemical and tissue culture studies also suggest that it is the cytotrophoblast which is responsible for its formation.

Other Protein Hormones. There are no convincing data to indicate that any other protein hormones are produced by the placenta besides the chorionic gonadotrophin.

Growth Hormone. The increase in the size of the foetuses in diabetic women has prompted the suggestion that the growth hormone secretion is increased in these women but there is no convincing evidence to prove that the growth hormone is produced by the placenta.

Relaxin. Though relaxin has been isolated from the human placenta, evidence is lacking that it is produced in the placenta. It is responsible for controlling relaxation of the pelvic ligaments.

Melanophore Stimulating Hormone. It is a well established clinical observation that increased melanin pigmentation occurs during pregnancy. MSH activity has been demonstrated in the urine and the placenta of pregnant women, but it has not been established whether the substance detected is of placental or pituitary origin.

Adrenocorticotrophic Hormone (ACTH). There is sufficient evidence to indicate that adrenal function is altered during pregnancy. ACTH activity has been demonstrated in placental extracts, but there is little evidence that it is produced in the placenta. Its presence in placental extracts is probably from the placental blood and from the hormones stored in the placenta.

Thyrotrophic Hormone. Although thyroid function is increased during pregnancy and, frequently, there is an enlargement of the thyroid gland, there is no evidence for the placental production of the thyrotrophic hormone.

Steroid Hormones

It is an accepted fact that all the steroid-producing endocrine glands can, as a rule, produce any of the steroid hormones. Besides producing oestrogen and progesterone, the ovaries also produce androgens. Similarly, the testes not only produce testosterone, but have the capacity to produce oestrogens and adrenal steroids; likewise, the adrenal glands, besides producing adrenocortical steroids also synthesise oestrogens, progesterone and androgens.

There is conclusive evidence that the placenta secretes oestrogens and progesterone. From progesterone, the placenta can synthesise testosterone, but evidence is lacking as to the capacity of the placenta to produce adrenocortical steroids.

Oestrogens. There is sufficient evidence that oestrogens are produced by the human placenta. The biosynthesis of oestrogens is from a series of steps ranging from acetate through cholesterol to the finished oestrogen.

Oestriol is formed not only from conversion of oestrone and oestradiol in the placenta, but the foetus also converts oestradiol and oestrone within its liver or other tissues. Another source of oestriol is conversion from a hydroxylated androgen by the placenta. Of the three oestrogens—oestradiol, oestrone and oestriol—the oestriol level increases one thousand fold over the non-pregnant level, while the oestradiol and oestrone levels rise a hundred fold. After delivery, the oestradiol and oestrone levels in the

urine return to normal within 4 days, while the oestriol level remains elevated for almost three weeks.

Urinary oestrogen levels predict foetal viability or distress in late pregnancy. Zondek states that, after the fifth or the sixth month, oestradiol levels below 3 mg. per 24 hours indicate foetal distress; while oestriol levels below 1 mg. per 24 hours suggest irreversible change.

Progesterone. Progesterone is an essential hormone of pregnancy. Progesterone prepares the endometrium for implantation and, after pregnancy has been established, it maintains suitable maternal environment including myometrial contractility.

It has been estimated that the placenta in late pregnancy produces at least 250 mg. of progesterone each day. The biosynthesis of progesterone is from acetate through cholesterol to the final product.

Pregnanediol rises in the urine during pregnancy upto the thirty second week when it apparently plateaus. The average value of excretion of pregnanediol after the thirty second week is 40 mg. per 24 hours. One week after delivery, the values are down to 2 to 3 mg. per 24 hours.

Pregnanediol values have been utilised in predicting imminent abortion. Later in pregnancy, a low or falling curve indicates irreparable placental failure.

Adrenocortical Steroids. There is little conclusive evidence that the placenta secretes any adrenal steroids; at any rate, not enough is made in the placenta to replace adrenal function. Elevated adrenal steroids in placental extracts are probably from the trapped blood in the placenta.

A convincing evidence that the placenta does not produce adrenal steroids is based on clinical observation that cases of natural adrenal insufficiency and those of adreno genital syndrome require replacement cortisone therapy during pregnancy.

Placenta As An Organ Of Transfer Of Materials

Thirty years ago, the placenta was regarded simply as a semi-permeable membrane across which various substances diffused in both directions. In 1927, Grosser put forward his morphological classification of chorioallantoic placentas, based on the number of layers which intervened between the maternal and foetal blood, and most of the present day knowledge of the "transfer" function of the placenta has developed since then.

The transfer of substances between the maternal and foetal circulations is a complicated process and the main factors participating are briefly reviewed below.

"Placental Barrier". Wislocki defined the "placental barrier" as those tissues of a developing ovum or embryo which are in contact with maternal tissues or fluids at any stage of gestation and which mediate the transfer of substances from the mother to the foetus or in the reverse direction. The trophoblastic layer represents the active parenchyma.

According to this definition, the placental membranes constitute a part of the placental barrier. Water and electrolytes are transferred to the foetus by way of the amniotic fluid but, for most other substances, the transfer by way of placental membranes is negligible.

Grosser's classification of placentas upon the basis of the tissue layers separating maternal and foetal blood is reproduced to show the evolutionary change. Grosser's classification was modified by Mossman who added the fifth type—the haemoendothelial type (Plate 28).

The layers which form the placental barrier in the human placenta vary at different terms of pregnancy. In the early weeks of pregnancy, the size of the individual villus is considerably large as compared to the villus at term. The villus upto the twentieth week is covered by syntrophoblast and cytotrophoblast and contains a few capillaries in its stroma. After the twentieth week, the cytotrophoblast almost disappears and is represented by a flattened structure compressed between the syncytium and the basement membrane upon which the trophoblast rests. There is an increase in the number of foetal capillaries. The walls of the villus capillaries progressively thin out and, as pregnancy advances, the structure of the villus barrier is appreciably thinned.

Though the size of the individual villus is considerably smaller in the latter half of pregnancy as compared to the first half, yet there is an enormous increase in the total surface area of the villi, brought about by an increase in the number and complexity of the branching villi. Various estimates of the total surface area of chorionic villi have been made with an average of about 15 square metres or 17.94 square yards.

As pregnancy advances, the increased permeability of the placenta is due to the reduction in thickness of the placental barrier and increase in the number of thinned out villus capillaries, and

the enormous total surface area exposed to the maternal blood in the intervillous space.

Intervillous Space. The intervillous space is like a reservoir which is kept filled with blood all the time. There are several interesting features which facilitate the transfer of nutritive substances from the mother to the foetus, and waste products from the foetus to the mother.

It was formerly believed by Grosser and others that during uterine contractions, the placenta was "squeezed like a sponge". This, however, is not true as shown by Caldeyro-Barcia and co-workers. They have shown that, during uterine contraction, the pressure in the intervillous space is about 40 mm. Hg, and that there is a concomitant rise in the intra-amniotic pressure. During uterine relaxation the pressure in the intervillous space is about 5-10 mm. Hg, almost the same as the intra-amniotic pressure.

Equality of hydrostatic pressure, both in the intervillous space and in the amniotic fluid during uterine contraction and relaxation, signifies that the intervillous space is always filled with blood and that the exchange of substances between the mother and the foetus is carried on continuously.

Another significant observation reported by Reynolds is that the foetal capillary pressure is always higher than that in the intervillous space. During uterine relaxation, the pressure in the intervillous space is 5-10 mm. Hg, while that in the foetal capillaries is between 30 to 35 mm. Hg. During uterine contraction, the intervillous pressure rises to 40 mm. Hg and there is a corresponding rise in the foetal capillary pressure. This higher foetal capillary pressure prevents the collapse of the chorionic villi, and the stoppage of foetal blood flow through the placenta. This mechanism ensures the continuous transfer of substances from the foetus to the mother. This higher pressure in the foetal capillaries indicates that the transfer of substances from the mother to the foetus must occur against considerable hydrostatic pressure gradient.

Modes of Transfer

(1) **Diffusion.** This is a rapid mode of transfer. Water and electrolyte molecules are exchanged across the placenta by diffusion. Normally, diffusion from one compartment to the other, across a semi-permeable membrane, occurs from the side having a higher hydrostatic pressure to the lower. In the case of the "pla-

ental barrier", diffusion is effected by the difference in the hydrostatic pressures between the foetal capillaries and the intervillous space.

All substances of low molecular weight, below the range of 350 to 450, can diffuse across the placenta in both directions.

Gaseous exchange of oxygen and carbon dioxide across the placenta is by diffusion. Most anaesthetic gases also pass rapidly through the placenta in a similar manner.

(2) *Active Transfer by Enzymatic Carriers.* These "carrier" molecules reside within the cytoplasm of the syntrophoblast. These molecules are presumed to be oscillating with great rapidity between two of the interfaces of the placental membrane. On the maternal surface of the syntrophoblast, these molecules carefully select the substances essential for the nutrition of the foetus and transfer them to the foetal surface of the trophoblast, from whence they enter the foetal circulation.

Essential carbohydrates, amino acids and vitamins are transferred in this manner.

(3) *Pinocytosis.* By this mechanism, large molecules, such as maternal plasma proteins, can be transferred against the hydrostatic pressure gradient. Dempsey, by means of an electron microscope, showed that the surface of the syncytium consists of myriads of microvilli—"brush border"—which are in constant motion during life. These microvilli engulf tiny droplets of fluid and transfer them into the cytoplasm, and from there the droplets are presumed to be transferred into the foetal circulation.

This mode of transport is of negligible value for nutritional substances. Besides maternal plasma proteins, mineralogical substances are probably transferred in this manner.

(4) *Leakage through Large Pores.* Transfer of intact red cells do occur through tiny leakages in the placental barrier. Leakage of foetal blood cells from the foetus into a Rh negative mother, sometimes, leads to serious consequences to the foetus by iso-immunization of the mother. Another evidence in favour of leakage is the finding of foetal haemoglobin in some 5 per cent of all obstetric patients.

Transfer of Different Materials

The transfer of different substances can be considered on general terms because rates vary widely from one compound to another

or from one period of gestation to another. For most substances, the transfer occurs in both directions.

Water. Water crosses the placental barrier more rapidly than any other substance. The mechanism is not clearly understood and is certainly not altogether due to diffusion because it must diffuse against hydrostatic gradient. The placental villous pressure is about 20 to 30 mm. Hg higher than that of the intervillous space.

Water is also transferred along the membranes into the amniotic cavity from whence it reaches the foetus by way of the gastrointestinal tract. It is stated that the foetus drinks about one-fourth of the volume of the amniotic fluid every day.

Glucose and amino acids contain water molecules of hydration and water reaches the foetus along with these substances. When these compounds are utilised, the water molecules of hydration are released for utilization by the foetus.

Electrolytes. Sodium and potassium cross the placenta more slowly than water. As gestation advances the transfer is greater. Flexner and his associates have provided data for the rates of transfer of sodium. The peak rate of transfer of sodium from mother to the foetus occurs a month before term. The decline in the last month is attributed to the effective diminution of the surface by fibrin deposition.

Oxygen and Carbon Dioxide. Oxygen crosses the placental barrier from the mother to the foetus by diffusion, but the concentration of oxygen in the foetal blood is considerably lower than that in the maternal blood. This is compensated in nature by the rapid withdrawal of oxygen from the foetal blood by the foetus and also by the fact that the dissociation of foetal oxyhaemoglobin occurs at lower oxygen pressures than the dissociation of adult oxyhaemoglobin. It has been estimated that about 24 ml. of oxygen per minute is transferred from the mother to the foetus.

Carbon dioxide, being more soluble, diffuses easily and rapidly across the placental barrier, from the foetus to the mother.

Carbohydrates. The transfer of glucose across the placenta is by carrier molecules. They pick glucose molecules at one surface and then release them at the other. The reason for the concentration of glucose in the foetal blood being lower than that in the maternal blood is not known.

The source of fructose is by the synthesis of glucose in the placenta. The concentration of fructose in foetal blood is about

5 mg. per cent which is 50 per cent higher than the average value for maternal blood.

Proteins. Essential amino acids are transferred by carrier molecules. The amino acids are more concentrated in the foetal than in the maternal plasma and therefore diffusion does not appear to play a major part in the transfer of amino acids. There is evidence that there is a selective transfer of amino acids by the carrier molecules. Page and his associates infused into a maternal vein, prior to delivery, the two optical isomers of an amino acid d- and l-histidine. Infants born 10 minutes later showed an equal concentration of the natural l-isomer but a much lower concentration of the unnatural d-isomer. This shows the selective transfer of acceptable substances and rejection of others.

Lipids. Popjak studied the placental transfer of lipids in rabbits by injecting serum containing phospholipids labelled with radioactive phosphorus. He found that the placenta accumulated phospholipids but did not transfer it to the foetus even in the latter part of pregnancy when the maternal and the foetal circulations are separated only by a thin layer of endothelium of foetal blood vessels. It is concluded that most, if not all, of the foetal cholesterol and fatty acids are synthesized by the foetus itself.

From the experiments of Goldwater and Stetten, it is evident that some maternal cholesterol and fatty acids diffuse slowly across the placenta, but this is not the major source of foetal fats.

Vitamins. The foetal content of the water soluble vitamins, thiamine, pyridoxine, riboflavine, vitamin B₁₂ and ascorbic acid are considerably higher than in the maternal blood. By a series of experiments, Hagerman and Villee concluded that a precursor of free riboflavine, flavine adenine dinucleotide, enters the maternal surface but cannot leave the placental membrane. Enzyme splitting then occurs, yielding riboflavine mononucleotide and free riboflavine, both of which enter the foetal plasma.

It is probable that such metals as iron, magnesium, cobalt and calcium, all of which are complex molecules, cannot cross the placental barrier unless split by enzymatic action.

Steroid and Protein Hormones. These are relatively large molecules which diffuse slowly across the placental barrier. No other active transfer mechanism has been demonstrated. Migeon and co-workers were the first to prove that steroid hormones are transmitted from the mother to the foetus. By infusing hydrocortisone into a maternal vein for 30 minutes prior to delivery, the

foetal plasma levels were raised from an average of 4 to 77 micrograms per 100 ml.

It is surprising that chorionic gonadotrophins, which is produced by the foetal trophoblast, is found in very low concentration in the foetal blood. The rate of transfer of thyroxine is quite slow, but the transfer of tri-iodothyronine was more rapid.

With respect to the transfer of maternal insulin, pituitary hormones and parathyroid hormone, the data is insufficient to draw any conclusions.

Immunological Substances. These are substances having large molecules incapable of diffusion through cell membrane. Gamma globulins have a molecular weight of more than 100,000. The mode of transport is probably through 'leaks', large holes, in the membrane or by pinocytosis. It is striking that gamma globulins are transferred 15 to 20 times more rapidly than albumin, despite their greater molecular weight.

Transfer of intact red cells is through 'leaks' in the placental membrane. The serious consequences of leakage of red cells of a Rh positive infant into the maternal circulation of a Rh negative mother are too well known to recount here.

Anaesthetic Gases. Nitrous oxide, cyclopropane and ether diffuse rapidly from the maternal to the foetal circulation. McKechnie and Converse studied placental transmission of thiopentone (sodium pentothal) and found maximum concentration in the foetal blood immediately after the maternal injection, and that equilibrium between the two circulations was rapidly established. The rapid transmission of anaesthetic substances explains the depressant effect of these drugs on the foetus.

Sedatives and Analgesics. The respiratory centre of the foetus in utero is very susceptible to the depressant action of pain-relieving drugs. Roberts et al studied the alteration in the minute volume of the newborn in response to various analgesics administered to the mother during labour. The mean minute volume of newborn infants in the gas-and-air group was compared with that of those in the pethidine-gas-and-air group, and it was found that pethidine reduced the volume by 10-15 per cent. Pethidine has, therefore, a definite depressant effect on the respiratory centre of the infant. Bromides, chloral hydrate and salicylates also cross the placental barrier.

Sulphonamides and Other Antibiotics. Sulphonamides, in general, cross the placental barrier without difficulty. Bruno

studied the transmission of 'dosulphin', a mixture of sulphamerazine and "G 14289". In 30 women, 2 grams were injected early in labour and, on its completion, the maternal and foetal blood levels were tested. The foetal blood level was nearly identical with that of the mother.

Charles studied the placental transmission of antibiotics and found that penicillin, streptomycin, terramycin, aureomycin and chloramphenicol easily cross the placental barrier. Therapeutic levels were rapidly reached in the cord blood. Except penicillin, all the other antibiotics were found in negligible quantities in the liquor amnii.

Bromberg et al gave orally a single dose of 100 mg. of isoniazide during labour and found that this drug diffuses rapidly through the human placenta at term. In some cases, the concentration of isoniazide in foetal blood was even higher than in the maternal blood.

Quinine. Quinine crosses the placental barrier easily. Formerly, as much as 30-40 grains of quinine were given orally for medical induction of labour. It carried the risk of intrauterine death to the foetus, not necessarily from the placental transmission of the drug. At the present time the practice of employing quinine for induction of labour has been given up.

Insulin and Oral Hypoglycaemic Agents. Insulin does not pass the placental barrier because of its great molecular weight of 35,100. On the other hand, BZ-55, like the sulphonamides, crosses the placental barrier and affects the foetal carbohydrate metabolism. It must be noted that placental permeability increases towards the end of pregnancy.

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SECTION II

PHYSIOLOGY OF PREGNANCY

CHAPTER 1

CHANGES IN GENITAL ORGANS AND BREASTS IN PREGNANCY

Pronounced alterations occur in the genital organs and the breasts during pregnancy beginning immediately after the embedding of the ovum. Though the changes are most pronounced in the uterus and the other genital organs, all the tissues of the body are more or less influenced.

Uterus. The most apparent change in the uterus is the great increase in its size. The thick walled non-pregnant uterus, 6.5 cm. in length, 4.5 cm. in breadth, 2 cm. in thickness, gradually enlarges during pregnancy until at term it is about 30-32 cm. long, 24 cm. wide and 20 cm. antero posteriorly. From the non-gravid weight of 65 gm. (2 ounces), there is a progressive increase in its weight during pregnancy, and at full term the uterus weighs about 1,000 gm. (2.2 pounds). This increase in size and weight is chiefly due to the hypertrophy of pre-existing muscle fibres. To a lesser extent it is due to the formation of new muscle fibres and a considerable increase in the amount of elastic tissue. The hypertrophied muscle fibres of the pregnant uterus are from 2 to 5 times wider and 6 to 12 times longer than those of the non-pregnant uterus (Figs. 7, 8).

The enlargement of the uterus is most marked in the fundal region, and is apparent from the relative positions of the insertions of the tubes and the ovarian ligaments. Whilst they are just below the level of the fundus in the non-pregnant state, they are seen to be attached just above the middle of the uterus at full term.

The hypertrophy of the uterine muscle fibres is brought about in the early months of pregnancy by the action of oestrogens and, in the later months, by mechanical pressure exerted by the growing foetus.

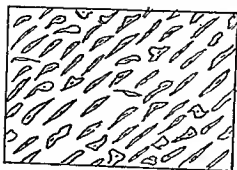


Fig. 7. Muscle fibres of non-pregnant uterus.



Fig. 8. Muscle fibres of pregnant uterus

Most important thing from a clinical point of view is the arrangement of the musculature of the pregnant uterus. During pregnancy, three layers of muscle are distinguishable: an outer thin, the middle very thick, and an inner thin layer. Since the development of the uterus is by fusion of the two Müllerian ducts, many of the fibres fuse with those of the tube and the uterine ligaments.

The outer longitudinal layer is hood-like, and covers the fundus and the anterior and posterior walls upto where the peritoneum is loosely attached. The fibres do not cover the sides of the uterus (Fig. 9).

The middle thick layer is composed of fibres which run obliquely through the wall of the uterus and bind all the layers together. Each fibre has a double curve and the crossing and recrossing of fibres form an interlacing network. The interlacing of

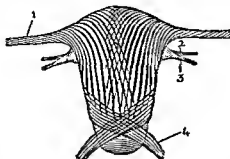


Fig. 9. Schematic drawing of the outer layer of uterine muscle fibres. 1, fallopian tube; 2, ovarian ligament; 3, round ligament; 4, utero-sacral ligament.

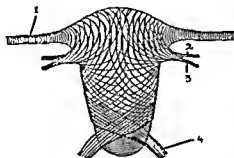


Fig. 10. Schematic drawing of the inner layer of uterine muscle fibres. 1, fallopian tube; 2, ovarian ligament; 3, round ligament; 4, utero-sacral ligament. adjacent fibres results in a formation resembling the figure of 8 (Fig. 10). The most important effect of the interlacing of fibres is the constriction of blood vessels coursing between them, when the fibres contract and retract after delivery. It is this prompt natural ligaturing of the blood sinuses that prevents post-partum haemorrhage.

The inner layer forms looped bundles of muscle around the tubal ostia and around the internal os. Prolonged annular contraction of the circular fibres around the internal os, occasionally results in obstruction to labour.

Cervix. The muscular fibres of the cervix have simpler arrangement. At the isthmus, the fibres are mostly running circularly. The supravaginal portion of the cervix has longitudinal and oblique fibres which anteriorly merge into the bladder along the vesico-uterine ligaments. The portio vaginalis has an inner circular and an outer longitudinal layer, and a middle layer which merges with the ligaments attached to the cervix as is found in the body.

Clinically, the most pronounced change in the cervix during

pregnancy is a marked softening, as early as 6 to 8 weeks after conception.

The cervical epithelium undergoes marked proliferation. There is marked proliferation of the epithelium and the glands. Basal cell proliferation at the squamocolumnar junction, at times, shows such variations in size, shape and staining properties that it simulates the histologic changes occurring in carcinoma in situ.

Blood Supply of Uterus. During pregnancy, the pelvic blood vessels are hypertrophied to compensate for the increased workload imposed upon them. As the uterus increases in size, the uterine artery adjusts its length by straightening out its tortuous non-gravid course. The ovarian vascular pedicle is enlarged. It is estimated that the capacity of ovarian veins is increased more than sixty times towards term.

Unusual changes occur in the blood vessels in the uterine wall. They lose their outer coats and form large blood spaces, lined only by the tunica intima. These large blood spaces are called sinuses.

The endometrial spiral arteries, characteristic of the progestational stage, are more coiled during the early weeks. Towards the 12th week, there is an abrupt change. The coiled arteries are straightened out and their number communicating with the intervillous space is decreased.

The blood flow through the uterus increases during pregnancy to meet the nutritional demands of the growing foetus and the enlarging uterus. Assali et al have estimated the uterine blood flow during pregnancy and have found the rate of the blood flow to be 51.7 ml. per minute at 10 weeks and 185 ml. per minute at 28 weeks.

Changes in Size, Position and Consistency of Uterus. For the first 10 weeks, the uterus is below the pelvic brim. It is globular in shape and soft in consistency. The cervix also softens early in pregnancy. The growing ovum, upto the tenth week, does not occupy the entire uterine cavity. The empty portion of the lower part of the uterus with the soft supravaginal portion of the cervix forms the basis of Hegar's sign of pregnancy. The uterus may be anteverted and anteflexed, or retroverted and retroflexed.

After the 12th week, the uterus rises out of the pelvis and becomes an abdominal organ. As it grows, it lies against the anterior abdominal wall, pushing the intestines and the omentum upwards. In many cases, the uterus has a tendency to dextrover-

sion and, in multigravidae with lax abdominal walls, this dextroversion may be marked, and the deviated uterine axis may occasionally lead to obstruction during labour. Similarly, in multigravidae with lax abdominal walls and with widely separated recti muscles, the unsupported uterus falls forward and a *pendulous* abdomen results. Here also, the deviated uterine axis causes obstruction to labour.

Axis of Uterus. In relation to the axis of the pelvic inlet, the axis of the uterus varies in primigravidae with tight abdominal walls and, in multigravidae with lax abdominal walls; it also varies in erect and supine position. The axis of the pelvic inlet is in a line drawn from the umbilicus to the tip of the coccyx. In primigravidae in erect position, the two axis frequently correspond. In supine position, the uterine axis lies behind that of the inlet (Figs. 11, 12).

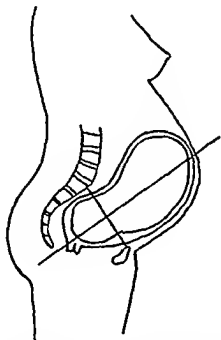


Fig. 11. Diagram showing the relation of uterine axis to axis of pelvic inlet in a primigravida in erect position.

Uterine Ligaments. The round ligaments are continuous with the uterine muscle and contract with the uterus. They hypertrophy and are 1 to 2 cm. thick as observed during caesarean section.

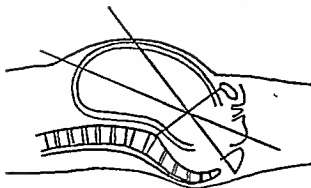


Fig. 12. Diagram showing the relation of uterine axis to axis of pelvic inlet in a primigravida in lying down position.

The uterosacral ligaments also hypertrophy and, being continuous with the uterine muscle, contract with the uterus.

The two layers of the broad ligaments are separated by the growth of the uterus and contain enormously enlarged blood vessels.

Ovaries. The ovaries are enlarged and one of them contains the corpus luteum. The corpus luteum functions actively during the first twelve weeks of pregnancy. The placental production of hormones after three months is so inadequate that the hormones, secreted by the pituitary, the ovaries, and the adrenals, play a secondary role during the remaining part of the pregnancy.

Decidual reaction occurs in response to the hormonal stimulus of the placenta.

Vagina. The vagina increases in length and capacity. It becomes more distensible by hypertrophy of the muscle fibres and an increase in the elastic tissue. The rugae become deeper and the squamous epithelium thickens.

The vagina contains a large number of saprophytic bacteria. Doderlein's bacillus predominates and so do other lactic acid-producing bacilli.

Pelvic Bones and Joints. The pelvic joints, the pubic, sacro iliac and the sacro-coccygeal joints soften and are relaxed in preparation for delivery. The increased elasticity of the joints gives a slight widening of the pelvic girdle during labour.

Breast Changes. These have been described later.

Endocrine Glands

Endocrine glands undergo important changes during pregnancy.

Thyroid. Moderate degree of hypertrophy is an accompaniment of pregnancy and is clinically observed in about two-thirds of the gravidae. There is true hyperplasia-of-the-glandular-tissue as well as the formation of new follicles. Increased thyroid activity is reflected in the increased metabolism during the later months of pregnancy. Towards the end of pregnancy the basal metabolic rate may reach 30 per cent above normal.

Parathyroid. Considering the increased demands of calcium during pregnancy and lactation, it is not surprising that the parathyroids undergo a marked hypertrophy. Inadequacy of the parathyroid hormone, sometimes, leads to tetany during pregnancy.

Pituitary. The anterior lobe of the pituitary undergoes markedly pronounced hypertrophy and may even double its size during pregnancy. The chromophobe cells are converted into chromophile cells with cytoplasm staining pink with eosin. The so-called 'pregnancy cells' are large ovoid eosinophil cells. Basophil cells also present striking changes. The posterior lobe of the pituitary does not undergo hypertrophy. This is surprising since its secretions have a determining effect on the contractions and the activity of the uterine musculature.

Adrenals. The cortex of the adrenal glands undergoes hypertrophy during pregnancy.

Nervous System. Mild upsets of mental equilibrium and functional disturbances are common during pregnancy. These are manifested by longings and cravings for unusual foods, irritability, insomnia, neuralgia, etc. Patients with neuropathic tendencies may develop gross disturbances.

CHAPTER 2

MATERNAL METABOLISM DURING PREGNANCY

Water and Crystalloid Balance During Pregnancy

Concepts in the field of water and crystalloid balance have undergone considerable change. In order to understand the physiological and pathological variations which occur during pregnancy, it is necessary to have a basic knowledge of physiology in the non-pregnant woman.

Water Balance in Non-pregnant Woman. Total Body Water. On an average, 55 per cent of the weight of the body in women is water, with a wide range from 45.6 to 59.9 per cent. Since one litre of water weighs 1 kg., a woman weighing 60 kg. would contain 33 litres of water. This estimate is based on the weight of well nourished European women. Taking the average weight of Indian women as 45 kg. (99 lbs.), the water content of the body would be 25 kg.

Distribution of Water. Water is in the cells, in the tissue fluid bathing the cells, and in the blood. The water in the cells is termed *intracellular*; and the remaining, that is that contained in the tissue fluids and in the plasma, is collectively called *extra-cellular*. The only difference between the composition of interstitial fluid and intravascular fluid is the presence of plasma proteins in the latter which considerably alters the osmotic pressure.

The volume of extracellular fluid is measured by administering a known amount of some substance—radioactive sodium or thiocyanate—and its degree of dilution in a subsequent sample of blood. As some amount of the substance diffuses into the cells, the estimate of extracellular fluid is not exact, being slightly higher. Intracellular fluid cannot be estimated directly and its volume is arrived at by deducting the calculated extracellular fluid from the total body water. The values given by Wright in 1952 are given below in tabular form.

Summarising the values it is apparent that most of the water is intracellular. The ratio of the plasma to the interstitial fluid the intracellular fluid is 2.5: 6.5: 24.

Maintenance of Daily Water Balance. In health, the intake

				Woman	Man (Wright)
Total body weight	..	..	..	60 kg.	60 kg.
Total body water	..	..	..	33 litres	42 litres
(i) Intracellular water	..	..	..	24 litres	30 litres
(ii) Extracellular water	..	..	..	9 litres	12 litres
(a) interstitial water	..	..	..	6.5 litres	9 litres
(b) plasma	..	..	..	2.5 litres	3 litres

and output of water must balance. There are great daily variations in the intake and the output which have to be accounted for. A rough estimate of daily intake and output as given by Wright in 1952 is as follows:

Intake

By mouth as fluid	..	..	..	1500 ml.
In food (so called "dry")	..	..	..	1000 ml.
From oxidation of food	..	..	..	300 ml.

Output

Urine	..	..	..	1500 ml.
Skin. Insensible perspiration	..	..	..	800 ml.
(Sweat)	..	..	..
Lungs	..	..	..	400 ml.
Faeces . .	..	..	..	100 ml.

The loss of water is increased as a result of visible perspiration, hyperpnoea and diarrhoea. The kidneys are the vital organs which adjust the balance according to the intake and the output of water.

Distribution of Electrolytes. The electrolyte composition of intracellular and extracellular fluids is markedly different. The main ions in the intracellular fluid are *potassium* and *phosphate*, while those in the extracellular fluid are *sodium*, *chloride* and *bicarbonate*. These two sets of ions are kept balanced by the permeability of cell membranes to these constituents.

It should be noted that chlorides, sodium, potassium and bicarbonates are present in all the three compartments; but in greatly different amounts. The cell membrane actively maintains this difference. Phosphate, being bound to intracellular proteins, does not diffuse across the membrane as do the other ions.

Approximate Electrolyte Composition of Three Compartments (Wright)

Plasma	Interstitial fluid	Intracellular fluid
Na + Cl' HCO' ₃ Protein	Na + Cl' HCO' ₃ —	K + HPO' ₄ — Protein

Sodium and Chloride Balance. Sodium is the chief cation in extracellular fluid. It has been estimated that a woman weighing 60 kg. has 53.6 gm. of sodium in her body. Not all of this is exchangeable, because sodium, which is stored in the bone, is only partly exchangeable. Estimation of concentration of sodium in intracellular and extracellular fluids varies; but according to one estimate, intracellular fluid contains 4.5 gm. and extracellular fluid 30 gm. of sodium.

The average daily intake of salt is 7-15 gm. on a mixed diet. The output is 4.6 gm. in urine per 24 hours; some sodium is lost in sweat and a negligible quantity in stools; but, in diarrhoea and vomiting, this loss of salt can be very great.

The intake and the output of chloride is almost exactly parallel to sodium and does not need separate consideration.

Potassium Balance. Potassium is the main cation in I.C.F. The total body potassium has been estimated to be 134 gm., of which 130 gm. is in I.C.F. and 4 gm. in E.C.F. There is no evidence that potassium is stored but, if it is, the likely place might be the muscles.

It has been estimated that 79 per cent of the total potassium excretion is in the urine and the remaining 21 per cent in the faeces. It should be noted that the loss of potassium in the faeces is considerable as compared to the 5 per cent loss of sodium in the faeces.

Control of Water and Electrolytes. There are two opposing factors governing the passage of fluid and electrolytes between the blood and the tissues. The osmotic pressure of the plasma proteins is 25 mm. Hg. At the capillary end, the intravascular pressure is 32 mm. Hg, and therefore the fluid is driven out into the tissues with all the nutrient components. At the venous end, the pressure is much less and, as a result, fluid is drawn in by an osmotic pressure of 25 mm. Hg, thus removing waste products.

It is the kidneys which mainly adjust the output and intake of fluid into the body. Large quantities of protein-free filtrate of

plasma is formed in the glomerulus, and from there, water and solutes are reabsorbed in varying quantities in various parts of the nephron. Absorption of water is under the direct control of the antidiuretic hormone (A.D.H.). The output of this hormone is regulated by the hypothalamus which is sensitive to many stimuli. The chief one considered here is the rise of osmotic pressure of the plasma supplying the brain. Thus, when blood is relatively concentrated by dehydration, A.D.H., which absorbs more water to dilute the blood again, is released.

The adrenals control the electrolyte balance. The hormones of the adrenals mainly affect the carbohydrate or mineral economy. Cortisone and hydrocortisone control the carbohydrate economy and are known as glucocorticoids. Aldosterone controls the mineral economy and is known as mineralocorticoid. Aldosterone seems to be the main hormone concerned with sodium balance. The stimulus to the secretion of aldosterone is a reduction in E.C.F. volume. Sodium is conserved by the kidneys together with the retention of fluid and thus the E.C.F. is expanded to its normal volume again.

Weight Gain During Pregnancy

During pregnancy every woman gains weight. Chesley (1944) gave a very comprehensive review of this problem. He found from analysis of 11,960 cases that, in 50 per cent of normal pregnancies, the average gain in weight is 11 kg. (24 lbs.), but, in some, the gain may be less than 6 kg. (13 lbs.) or as much as 17 kg. (37 lbs.). The average gain in weight is approximately 20 per cent of the initial body weight of the woman.

The average weight gain during the three trimesters of pregnancy is clinically significant. In the first trimester, there is an initial loss of weight due to anorexia and vomiting which is more than compensated towards the end of the trimester and the total weight gain is 2½ lbs. During the second and the third trimesters, the average normal gain in weight has been estimated as 10.8 lbs. and 11.2 lbs. respectively.

The gain in weight, that can be grossly accounted for, is 7.1 kg. (15 lb.): The foetus 3.2 kg. (7 lbs.), the placenta and membranes 0.5 kg. (1 lb.), the liquor amnii 1 kg. (2 lbs.); the uterus 1 kg. (2 lb.), the breasts 1.4 kg. (3 lb.). These are rough approximations, as the foetus may weigh 2.5 to 4.5 kg. (5½ to 9½ lb.) and

may still be normal. Similar wide variations can occur in the weight of the placenta, the liquor amnii, the uterus and the breasts.

The remaining 4 kg. (9 lb.) of the total gain of 11 kg. (24 lb.) is still unaccounted for. Presumably, the extra weight might be due to deposition of fat or proteins, or due to the retention of water. That fat is mobilized to help in the build up of the foetus, the placenta, the uterus and the breasts, is obvious from the fact that some women gain in weight less than 13 lb. and yet produce a normal sized foetus, placenta, enlarged uterus and breasts. Similarly, those women who gain excessive weight probably put on some fat. Retention of nitrogen and calcium are known to occur during pregnancy.

The blood volume expands by 1 to 1½ litres during pregnancy, thus accounting for 1 to 1½ kg. (2.3 lb.). A recent estimate by Freidberg suggests that the increase in E.C.F., apart from plasma, is 2.5 kg. (5.5 lb.). This leaves 0.5 kg. still unaccounted for and this gain is probably due to deposition of tissues.

Retention of Water and Distribution of Retained Water

It should be remembered that water is not only retained in the interstitial tissues, the plasma, the uterus and the breasts of the mother, but also in the foetus, in the placenta and the liquor amnii. Chesley (1944), by calculating the loss at delivery and during the puerperium, estimates that the increase in E.C.F. volume is 61 litres. The distribution of this retained E.C.F. during pregnancy is: foetus 0.96 litre, placenta 0.41 litre, liquor 1 litre, blood 1 litre, uterus 0.60 litre, breasts 0.5 litre and materoal tissue spaces 1.40 litres, giving a total of 5.87 litres. Though the interstitial fluid is distributed throughout the body, a large quantity is retained in the legs.

Sodium Retention During Pregnancy. Sodium is essential for the growth of the tissues of the foetus, the placenta, the uterus and the breasts; and therefore there is no mystery about the retention of sodium during pregnancy. Calculations have been made as regards retention of sodium. Five gm. is retained in the foetus, 2.3 gm. in the liquor amnii, 3.6 gm. in the breasts and placenta, 7.6 gm. in the E.C.F., and 2 gm. in the uterus, making a total of 20.5 gm. Sodium may be stored, in small amounts, in an osmotically inert form, in bone.

Potassium Retention during Pregnancy. About 11 gm. of potassium is retained during pregnancy, and, like sodium, its distribution in different parts is calculated: foetus 6.0 gm., placenta 1.0 gm., uterus 1.5 gm., breasts 1.9 gm., and E.C.F. 0.5 gm. Some potassium may be stored in various tissues, particularly the muscle which contains more potassium per unit weight than any other tissue.

Protein Metabolism

Considerable quantities of nitrogen in the form of protein is retained during pregnancy. This capacity to store nitrogen is evident early in pregnancy. In 1933, Munscher and associates reviewed the literature on nitrogen retention in pregnancy and, from 945 studies of daily nitrogen balance, they calculated that the average retention was 2.28 gms. per day over the last eight lunar months, which amounts to a total of 510 gm. It has been estimated that roughly 150 gms. of nitrogen can be accounted for: foetus 70 gm., placenta, cord and blood 18 gm., amniotic fluid 0.86 gm., uterus 38 gm., breasts 17 gm. The remaining 360 gm. is for the maternal organism outside the reproductive system. It is presumed that it is stored as protein, which would weigh about 6½ pounds. It is most likely that the stored protein is used in the formation of new tissue because, with the usual proportion of water in the tissues, the weight increase attributed to nitrogen store alone would be about 30 to 36 pounds. It is therefore likely that the nitrogen storage is somewhere in concentrated form, but the site of storage is not defined. Amino acid excretion is increased in pregnancy and this has been particularly studied for the amino acid histidine, which is excreted in the urine in markedly large amounts. The histaminase activity of the serum is greatly increased in pregnancy.

Carbohydrate Metabolism

During the early weeks of pregnancy, demands for carbohydrates are excessive. Frequently, the carbohydrate intake is considerably reduced as a result of persistent vomiting during the first three months. This unfavourable combination of reduced intake and excessive demands for glucose is likely to cause ketosis.

During pregnancy, there is an increased physiological activity of the anterior pituitary gland as a result of which there is an in-

creased secretion of adrenocorticotrophic, gonadotrophic and the growth hormones. The increased secretion of ACTH causes an increased output of glucocorticoids. One of the effects of excessive secretion of ACTH during pregnancy is renal glycosuria. The renal threshold is lowered from the normal 0.18 gm. per cent to 0.14 gm. per cent, or even less. The lowering of the renal threshold is due to interference with the renal reabsorption of glucose. It usually tends to occur, often quite suddenly, in the fourth or the fifth month.

The increased secretion of ACTH, as a result of overactivity of the anterior pituitary, increases the output of glucocorticoids (II-oxysteroids) by the adrenal cortex. As a result, the blood-sugar and liver glycogen are increased. The production of insulin is increased by increase in the size and number of islands of Langerhans.

Yet another effect of increased anterior pituitary activity is the direct conversion of proteins into carbohydrates. Increased activity of the thyroid during pregnancy stimulates mobilisation of glucose from the glycogen in the liver.

Serum Lipid in Normal Pregnancy

For many years it has been known that an increase in circulating lipids occurs during pregnancy. Lipid is a broad term and includes all substances which are insoluble in water but which are: (1) soluble in fat solvents, (2) related actually or potentially to fatty acid esters, and (3) utilised by animal organism.

Total Lipids. A mild depression in total lipids occurs at the twelfth week of pregnancy as compared with the normal non-pregnant control. After that there is a most significant rise after the twenty fourth week until term. By the sixth week of puerperium, there is a considerable decrease towards the normal but the level is still above the normal non-pregnant one.

Cholesterol. Total serum cholesterol, ester cholesterol and free cholesterol, all show a gradual increase from the sixteenth week onwards. By the sixth or the seventh week postpartum, there is significant fall in the level but not to the normal non-pregnant value.

Phospholipids. There is not much rise upto the twenty fourth week, but after that there is a sharp rise in the concentration of phospholipids until term. At the end of the sixth week of puer-

perium, the concentration of phospholipids is still well above the normal non-pregnant level.

By using newer techniques, there seems to be a general agreement that, during normal pregnancy, an increase occurs in total lipids, cholesterol and phospholipids. It has also been shown that beta lipoproteins increase relatively more than the alpha lipoproteins.

The factors responsible for these changes are, however, not clearly understood. Extensive studies have failed to show definite causal relationship between lipid metabolism and the steroid hormones of the adrenals and the ovary. While the oestrogens effect an increase in alpha lipoprotein; pregnancy produces an increase in beta lipoprotein.

Iron Metabolism

The total body iron in adult is 4.5 gms., of which about two-thirds is present in haemoglobin, one-fifth is stored in the liver, the spleen and the bone marrow, and the remainder is in myohaemoglobin as enzymatic iron.

Daily Requirements. Dietary iron is usually in the form of ferric hydroxide, and may be loosely combined with organic and amino acids. The average normal daily diet contains 10 to 20 mg. ionic iron. Roughly, 10 per cent of the daily dietary iron is absorbed, the remainder passes unabsorbed in the faeces. Thus, about 1-2 mg. of ionic iron is sufficient for the daily requirements of an adult male; but the female, due to her cyclic menstrual loss, needs more than 2 mg. daily. During pregnancy, more than 3 mg. daily are necessary for meeting the increased demands of the foetus.

Assimilation of Iron. Iron is absorbed from the food in the digestive tract, mostly in the duodenum. The absorption of iron is controlled by the needs of the body for iron. The mucosal cells are responsible for controlling the absorption of iron. The absorption is increased in iron deficiency anaemias following sudden blood loss and during pregnancy.

Only ferrous iron can be absorbed from the lumen of the digestive tract by the mucosal cells. Ferric salts have to be converted to the ferrous state in the stomach by hydrochloric acid, organic acids, and vitamin C which is also a reducing agent. Ferrous ions are oxidised in the mucosal cells to produce ferric hydroxide, and this combines with the apoferritin protein present in these cells to

form ferritin. When all the apoferritin has been converted to ferritin, further absorption into the mucosal cells from the alimentary tract ceases. Due to low oxygen supply, the iron in ferritin is reduced to the ferrous state again, and enters the blood stream. It is once again oxidised to the ferric state in the blood, and then combines with the plasma iron, binding B. globulin (transferrin or siderophilin). Transferrin constitutes 3 per cent of the total plasma proteins. The normal total iron-binding capacity is about 300 micrograms per 100 ml. Transferrin is only one-third saturated with iron. Transferrin, as its name suggests, transports iron to the bone marrow, the reticulo-endothelial system, the liver, and the spleen. Iron is stored as ferritin or haemosiderin.

Normally, only one-third of the iron-binding capacity is utilised. When the stores are full, no more iron can be transported by transferrin, and the control mechanism of the mucosal cells comes into play by stopping absorption of the iron from the digestive tract.

Vitamin B₁₂ and Folic Acid Metabolism

Vitamin B₁₂ taken by mouth in physiological doses is absorbed only in the presence of intrinsic factor produced by the mucosa of the stomach. Although the nature of the intrinsic factor is not known, it binds vitamin B₁₂ for a time, and then makes it available to the mucosal cells for absorption. In the serum, vitamin B₁₂ is partly bound to an alpha-globulin and is partly in a free form.

Folic acid, in the presence of ascorbic acid and vitamin B₁₂, is converted into folinic acid, which is an intermediary product for normal nucleic acid nucleoprotein synthesis. Nucleic acid and nucleotides are necessary for normal haematopoiesis.

During pregnancy there is probably a decreased absorption of vitamin B₁₂ and serum B₁₂ is lowered. Folic acid levels, on the other hand, are high during pregnancy, and fall at parturition. The foetus requires a large amount of nucleoprotein for its tissue synthesis, and draws on the maternal stores of B₁₂ and folic acid. This is evident from the cord serum levels of B₁₂ and folic acid being considerably higher than maternal serum values.

Deficiency of synthesis of nucleoproteins, as a result of folic acid, B₁₂ and ascorbic acid deficiency, results in megaloblastic anaemia.

Calcium Metabolism

The foetus needs calcium for its osseous development and meets this demand by drawing on the maternal calcium. Upto about the thirty-second week, the calcium utilized by the foetus is about 8-9 gms. but, during the last four weeks, osseous development proceeds at a greater pace and as much as 16-17 gms. are drawn during this short period.

It has been shown that a woman, having a balanced diet stores about 50 gm. of calcium and about 35-40 gm. of phosphorus during the course of pregnancy. Since, only half the amount of the stored calcium is required by the foetus, the remainder is stored in the maternal tissues. There is a slight progressive diminution of total maternal serum calcium during pregnancy. This slight decline is of the non-diffusible protein-bound calcium, while the concentration of the physiologically active, diffusible calcium ion remains unaffected. The decline of protein-bound calcium is attributable to the retention of the plasma proteins during pregnancy. Daily requirements of calcium rise during pregnancy from 400-500 mg. in the non-pregnant state to 1000-1200 mg. in the last trimester of pregnancy.

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SECTION III

DIAGNOSIS OF PREGNANCY AND ANTENATAL CARE

CHAPTER 1

DIAGNOSIS OF PREGNANCY

It is frequently necessary to arrive at an early diagnosis of pregnancy, particularly in women who have had one or more previous abortions. It is, therefore, necessary to be familiar with the various signs and symptoms of early pregnancy. After the twelfth week, the enlarged uterus is felt per abdomen and the evidence of normally progressing pregnancy is more readily available. The unfortunate results, both on to the patient and the medical attendant, of a mistaken diagnosis of pregnancy should be kept in mind and all the positive and negative evidences should be properly evaluated. It may be possible to give a diagnosis of pregnancy with certainty or it may not be possible to give a definite opinion, and, whenever there is some doubt, a guarded opinion should be given or aid of one of the biological tests should be sought.

The diagnosis of pregnancy is made from: (1) history, (2) breast changes, (3) abdominal examination, (4) vaginal examination, (5) biological tests, and (6) radiological examination.

History

Amenorrhoea. A patient usually considers herself pregnant when her menstrual periods are suppressed. The previous menstrual history must be obtained, for it is only the sudden cessation of periods in a regularly menstruating woman that is strongly suggestive of pregnancy. In a woman, who is having menstruation at prolonged intervals, amenorrhoea is not a strong evidence of early conception.

It should be remembered that amenorrhoea may occur from several other causes. During or after a febrile illness, temporary

cessation of menstruation frequently occurs. Amenorrhoea is often present in severely anaemic women. Similarly, chronic illnesses, particularly tuberculosis and malaria, suppress menstruation. Conception may take place during lactation amenorrhoea and the patient may not be aware of it until 'quickening' occurs. Fear of pregnancy or sudden emotional shock are likely to suppress menstruation. Lastly, functional uterine bleeding is, sometimes, punctuated by periods of amenorrhoea.

Nausea and Vomiting. The conventional term 'morning sickness' is not used because, in many women, nausea and vomiting occur at any time of the day and not only on awakening in the morning. It usually commences soon after missing the first period but, in some, it may start earlier, even before missing the period. It is worse between the sixth and the tenth week and usually passes off about the end of the third month; but its onset, duration and intensity are very variable. It may be as mild as distaste for certain articles of food, or the patient may vomit once or several times a day. In some, it occurs at some particular time each day. It may be severe and may cause incessant vomiting which is pathological, and is termed hyperemesis gravidarum.

Severe nausea and vomiting are more common in nervous, highly strung women of the upper social class. It is also usually severe in women who do not desire conception.

Frequency of Micturition. A number of women have an increased frequency of micturition, both by day and by night, during the first three months. It is caused by the pressure of the bulky anteverted uterus on the base of the bladder. In some, this marked frequency develops so suddenly after the first period is missed that the patient complains of it; but, in others, it remains unnoticed, and the complaint of frequency of urine is elicited on directly questioning the patient.

Quickening. From about the eighteenth to twentieth week, slight flutter in the lower abdomen is felt by the patient. At first, the flutter is so slight and occurs so infrequently that inexperienced primigravidae are often not conscious of it until much later. Gradually, the flutter is more intense and occurs much more frequently.

Breast Changes

Breast changes commence in the second month, and are both subjective and objective.

Fullness of the breasts and tingling pains are usually noticed by the patient, and are useful early subjective evidences in primigravidae.

Appreciable enlargement is noticeable towards the completion of the second month and, as pregnancy advances, the breasts become larger, firmer and nodular. The appearance of distended blue veins, which in some women form an intricate network under the skin, is an early objective breast change.

Alterations in Nipples and Areola. Pigmentation of the nipples and the areola are noticeable by the end of the second month. The woman may herself have noticed the deepening of the colour or may become aware of it on direct questioning. It is said to be more marked in brunettes than in blondes. The nipples become turgescient and long, and many women complain of tingling sensation in the nipple area (Plate 29).

The Montgomery's follicles, distributed in the areola, become more prominent and project above the surface. It is an early change which the patient frequently fails to notice until her attention is drawn to it. The secondary areola appears after the fifth month. It is an irregular, pigmented area surrounding the primary areola. It is clinically unimportant, as there are several other positive signs of pregnancy by then.

A few drops of watery secretion can be squeezed out of the nipples from the end of the third month. In primigravidae, it is a diagnostic sign. In some multigravidae, thick creamy secretion persists even after lactation and has no diagnostic significance but, when watery secretion can be obtained from one of the ducts, it is significant of a fresh conception.

Abdominal Examination

Before the end of the twelfth week, the pregnant uterus remains a pelvic organ. An anteverted gravid uterus is sometimes palpable just above the upper margin of the symphysis pubis, even before the twelfth week; while a retroverted uterus takes a longer time to rise out of the pelvis and, frequently, the upper margin is not felt until the end of the thirteenth week. Therefore, the diagnosis of pregnancy for the first twelve weeks is made only on vaginal examination.

Inspection. Pigmentation. In many women, the linea alba is visible as a well marked brown line. In some cases, the groin area also is brown pigmented.

Striae Gravidarum. In many women, irregular lines are seen in the skin of the abdominal wall below the umbilicus. These lines are due to stretching of the dermis caused by progressive distension of the abdomen. The occurrence of striae is variable and depends on elasticity of the individual's skin. Some women have few or no striae even after several pregnancies, while others have numerous striae in their first pregnancy. Striae are likely to occur more in obese than in thin women. Overdistension of the uterus by hydramnios or multiple pregnancy almost always disfigures the skin by multiple striae. The striae are pink in the first pregnancy, but become white and remain so subsequent to the first confinement. In some, particularly obese women, the striae are seen on the upper thighs and gluteal regions. Increased activity of the glucocorticoids during pregnancy is believed to play a causative role in the development of striae (Plate 30).

Foetal Movements. In the later part of pregnancy, foetal movements are sometimes visible. They are more apparent in multiparae having a thin and lax abdominal wall. Occasionally, they appear so superficial as to arouse a suspicion of abdominal pregnancy.

Changes of Size and Shape. After the fourteenth week, enlargement of the abdomen is visible. In a vertical lie, it is elongated in shape, convex in the centre, without bulging of the flanks. In posterior positions of the vertex, the abdomen is flattened in the centre, and is bulging in the flanks. In a transverse lie, the abdomen is more broad and shorter in length as compared to the term of pregnancy.

Palpation. After the sixteenth week, diagnosis and duration of pregnancy can be easily made by detection of the following signs:

External Ballotment. From about the sixteenth week until the end of the twentieth week, the entire foetus can be moved inside the uterine cavity. To elicit external ballotment, a hand is placed on either side of the uterus, and when gentle pressure is given by one hand the moving away of the foetus from that side to the opposite side is felt as a repercussion by the other hand. It is a reliable sign to differentiate a normal pregnancy from a molar conception, from uterus uniformly enlarged by a fibromyoma and from an ovarian cyst. External ballotment might be simulated by a subperitoneal pedunculated fibromyoma, or a malignant ovarian mass floating in ascitic fluid.

Foetal Parts. From the twenty fourth week onward, the dif-

ferent parts of the foetus can be recognised by abdominal palpation. Frequently, the active movement of the foetus can be felt by gently pushing it away when it may respond by a movement.

Intermittent Contractions. Braxton Hicks was the first to recognise the occurrence of intermittent painless uterine contractions. The description given by him is quoted here: "If, then, the uterus be examined without friction or any pressure beyond that necessary for full contact of the hand continuously over a period of from five to twenty minutes, it will be noticed to become firm if relaxed at first, and more or less flaccid if it be firm at first. It is seldom that so long an interval occurs as that of twenty minutes; most frequently, it occurs every five or ten minutes, sometimes even twice in five minutes".

Braxton Hicks' sign is valuable as a corroborative sign, particularly in a uterus overdistended by hydramnios, when foetal parts cannot be palpated. Such an overdistended uterus is likely to be mistaken for an ovarian cyst, but the occurrence of intermittent contractions definitely excludes an ovarian cyst.

Auscultation. Foetal Heart. The foetal heart sounds can be distinctly heard from after the sixth month. The rate varies between 120-140 per minute. At the sixth month, they are usually best heard in the middle line, but, after the twenty-eighth week, their location is determined by the position and lie of the foetus. They are likely to be confused with the maternal heart sounds, but the error can be readily avoided by comparing their respective rates.

Funic or Umbilical Souffle. The rate corresponds with the foetal heart rate. It is a blowing sound produced by some obstruction to the flow of blood in the cord. Persistent bearing of funic souffle is likely when a loop of the cord is round the neck of the foetus.

Uterine Souffle. It is a soft blowing sound synchronous with the pulse of the mother. Its mode of occurrence is not definite, but it is probably due to the passage of blood through the uterine vessels.

Vaginal Examination

In the early weeks of pregnancy when the uterus is a pelvic organ, diagnosis of pregnancy can only be made by a vaginal examination. In the later months, even when pregnancy can be de-

finitely diagnosed by abdominal palpation, a vaginal examination should not be omitted, because a pelvic tumour or malignancy of the cervix will be occasionally detected.

Alterations in Colour of Vulvar and Vaginal Mucous Membrane. Purplish blue discolouration of the vulva and the vagina appears from the second month and increases in intensity during the next three months. It is seen on the inner side of the vulva and in the vagina; it increases in intensity from below upwards. It is due to increased vascularity and, sometimes, occurs apart from pregnancy. It is a corroborative evidence of pregnancy.

Change in Size, Shape and Consistency of Uterus. In the early weeks of pregnancy, the uterus becomes globular and soft. When there is doubt about the ovum having perished, the consistency of the uterus is a fairly good guide because an enlarged soft uterus indicates a live ovum. A uterus enlarged by a single intramural fibromyoma may confuse diagnosis when the fibromyoma has been softened by extensive hyaline degeneration.

Softening of Cervix. The cervix softens from the second month and, as pregnancy advances, it is so softened that it affords a marked contrast to the non-pregnant, firm cervix. In the early months, a definite vaginal portion of the cervix is felt, but, after the twenty fourth week, the cervix is gradually 'taken up', and the portio vaginalis is gradually reduced in length. Softening of the cervix during pregnancy is characteristic and is not simulated by any other condition.

Hegar's Sign. It can be elicited between the sixth and the tenth week. Upto the tenth week, the ovum occupies the upper part of the corpus, and the softened isthmus and the supra vaginal portion of the cervix are readily compressed during bimanual palpation thereby giving the impression of the fingers of the two hands meeting each other. When the uterus is anteverted, two fingers are inserted into the vagina, and the tips are placed in the anterior fornix. The external hand is placed on the abdomen over the posterior wall of the uterus bringing the tips of the fingers to a level as near as possible to the fingers in the anterior fornix. By gentle pressure of the two hands, an attempt is made to make the internal and the external fingers meet. When the uterus is retroverted, the sign is elicited by placing the vaginal fingers in the posterior fornix and the abdominal hand is placed on the anterior wall of the uterus by dipping the fingers from above the symphysis pubis.

It is a very reliable sign and is characteristic of early pregnancy. After the tenth week, the ovum occupies the lower part of the uterus also, and the sign cannot be elicited. The bladder must be empty and the sign is better elicited when the subject is thin and abdominal wall is relaxed (Fig. 13).

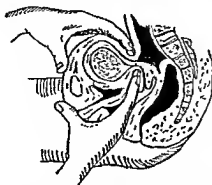


Fig. 13. Bimanual vaginal method of detecting Hegar's sign.

Internal Ballotment. From about the end of the fourth month, the foetus is large enough to be ballotted by the fingers placed in the vagina. Internal ballotment can be elicited at an earlier stage of pregnancy than the external ballotment. It is a useful sign when external ballotment is unsuccessful, as in obese women, women having a tense abdominal wall and in molar pregnancy. To elicit the sign, the patient is kept in the dorsal position with the shoulders well raised so that the foetus tends to fall in the lower part of the uterus. Two fingers are placed in the anterior or the posterior fornix depending on from which of the fornices the foetus can be well felt. Two fingers are placed in the anterior fornix and an upward thrust is made by the fingers. If there is a foetus, its gravitation into the lower part can be felt by an impact on the tips of the fingers. If an impact is not elicited, a similar attempt is made from the posterior fornix (Fig. 14).

Palmer's Sign. The rhythmic contraction and relaxation of the uterus can be elicited at intervals of one minute during the early weeks of pregnancy. Upto about the eighth week, each contraction lasts for about 30 seconds, followed by relaxation of an equal duration. After the tenth week, the interval between each contraction is progressively lengthened. The palpation of these frequent intermittent contractions during bimanual examination aids in the diagnosis of pregnancy.

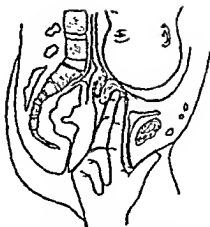


Fig. 14. Method of detecting internal ballotment.

Biological Tests

Since the introduction of a biological test by Aschheim and Zondek in 1928, the diagnosis of pregnancy has been considerably simplified. The test depends on the excretion of luteinizing gonadotrophic hormone in the urine of pregnant women. The Aschheim Zondek test is performed on isolated immature mice, but many other modifications have since been made, and several other animals are utilized for this test.

Aschheim Zondek Test. The chorionic gonadotrophins in the urine of pregnant women produce a precocious ovarian cycle in immature mice. Small quantities of urine are injected, several times daily for three days, into two or three weeks' old immature white mice. The animals are killed on the fifth day and examined for the presence of haemorrhagic follicles in the ovaries.

Friedman's Test. Early morning sample of urine is collected on two successive days and is stored in a refrigerator. If any precipitate is present it is removed by filtering or centrifuging. Eight c.c. of urine are injected in the morning, evening and the next morning in the aural vein of an isolated, at least seventeen weeks' old, mature female rabbit. The ovaries are examined for haemorrhagic follicles and corpora lutea 48 hours after the injection.

Indian Male Toad Test. The Indian male toad, *Bufo melanostictus*, is easily available in India and is very suitable because it does not show seasonal variations in response to the gonadotrophin. The specimen of urine is kept in a cool dark place before use. In order to avoid mortality amongst the animals, concentrates of urine, instead of neat urine, is used. The urine is concentrated

by Weisman and Coates Method. Twenty c.c. of acetone are added to 10 c.c. of urine and the precipitate is allowed to settle. The precipitate is dried free from acetone by means of a suction pump and suspended in 1 or 2 c.c. of distilled water. The clear supernatant fluid after centrifuging the aqueous suspension is injected very slowly in the dorsal lymph sac and the needle withdrawn several seconds after the material has been injected. The cloacal contents are examined microscopically for spermatozoa at hourly intervals for four hours. The presence of sperms indicates positive reaction, irrespective of motility or otherwise of the sperms.

Twenty Four Hour Rat Test. The usual morning sample of urine is to be collected, at least 50 c.c. in a clean glass bottle. Catheterization is not essential; a mid stream sample directly collected into the bottle is sufficient. Water intake is to be restricted on the previous evening and night.

In the laboratory the urine is filtered and tested for albumin and sugar. Two c.c. of the filtered urine are then injected subcutaneously in the abdomen on one side and another 2 c.c. on the opposite side after four hours. The animal used in the test is the white female rat 20 to 40 days old.

The animal is killed and the abdomen opened after 24 hours when enlarged congested ovaries with haemorrhagic corpora lutea denote positive result.

For quantitative test, dilute urine 1/100 and inject two doses each of 2 c.c. as usual.

Immunological Pregnancy Test. (Wide-Gemzell Test). Although these biological tests are mostly reliable and rapid, the common draw-back about these tests concerns the universal availability of suitable animals throughout the year. With the report of Wide and Gemzell, it now appears that an equally reliable and rapid test without using an animal is within our reach. The principle underlying the Wide-Gemzell test is immunological wherein neutralisation of immune antibodies against human chorionic gonadotrophin (HCG) takes place if the suspected urine contains HCG. Such neutralisation, if it takes place, is demonstrated by the hemagglutination inhibition reaction using sheep red blood cells coated with HCG.

Radiological Examination

Radiological investigations have been described in a later section.

Differential Diagnosis of Pregnancy

Though the diagnosis of pregnancy has been considerably simplified by employing the biological tests and radiological examination in doubtful cases, still the clinical sense must be fully employed before hurriedly resorting to these special investigations. The present trend of by-passing the clinical evaluation of the diagnosis of pregnancy is unfortunate. To remain a good clinician, the student should always attempt to diagnose pregnancy by the various clinical signs, and to seek the help of the laboratory only when necessary.

Differential Diagnosis before the Sixteenth Week of Pregnancy

Uterine Pregnancy with Lateral Flexion of Uterus. A laterally flexed pregnant uterus of 8 to 10 weeks' size is likely to cause confusion. The important point to bear in mind is that whenever a mass is palpated in one of the fornices and the uterus cannot be felt separately from the mass, further observation and examination, if necessary under anaesthesia, must be done. It will then be possible to correct the laterally flexed gravid uterus into an anteverted position, and the mass which was previously felt in the fornix is proved to be the gravid uterus.

Incarcerated Retroverted Gravid Uterus and Pelvic Haematocele. The incarceration of a retroverted gravid uterus occurs between the twelfth and the fourteenth week. It is generally mistaken for an ectopic pregnancy in the third month of gestation. Dysuria and, later, retention of urine occur in both the conditions. In both, the cervix is pushed behind the symphysis pubis, but in the case of a retroverted gravid uterus, it is directed well forward also. In a retroverted gravid uterus, the fundus or any part of the uterus is not felt separate from the mass in the pouch of Douglas, while in pelvic haematocele a small portion of the uterus or the whole of it can be palpated on the top of the mass. A retroverted gravid uterus is uniformly firm, while a pelvic haematocele is of irregular consistency, being soft in some places and firm in others.

Uniform Enlargement of Uterus by A Single Intramural Fibromyoma. Difficulty frequently arises in excluding pregnancy. In every case of doubt, pregnancy must be excluded by a biological test or radiological test before deciding upon an operation. Even on opening the abdomen, it is, at times, difficult to differen-

tiate between a pregnant and a soft fibromyomatous uterus. In such confusing cases, a long needle with a syringe attached to it should be passed into the uterine cavity. Drawing of liquor amnii is a conclusive evidence of pregnancy.

Dysfunctional Uterine Bleeding. In some cases, bouts of bleeding occur after intervals of 6-10 weeks' amenorrhoea. The uterus is often enlarged to about 6-8 weeks' pregnancy. Amenorrhoea associated with enlargement of the uterus is sometimes mistaken for a uterine pregnancy and the subsequent bout of bleeding for an abortion.

Ovarian Tumour associated with Uterine Pregnancy. The enlarged uterus and a small ovarian tumour lying side by side in the pelvic cavity form an indefinite mass and confuse diagnosis. If the cyst can be pushed up out of the pelvis during a bimanual examination, the enlarged pregnant uterus can be readily identified. The confusion is greater when the cyst is incarcerated in the pelvis, because the acute abdominal pain and other signs of an abdominal emergency with amenorrhoea lead to a mistaken diagnosis of an ectopic pregnancy.

Differential Diagnosis after the Sixteenth Week of Pregnancy

As a rule, uterine pregnancy can be confidently diagnosed by abdominal palpation and auscultation of foetal heart sounds, but there are occasions when diagnosis is in doubt. In addition to the biological test, radiological evidence of a foetal skeletal shadow clinches the diagnosis. The following conditions cause confusion in diagnosis:

Pregnancy in a Fibromyomatous Uterus. It is difficult to palpate the foetus in a uterus containing multiple fibromyomata. Positive internal ballotment helps in diagnosis. Hearing of foetal heart sounds is a definite sign of pregnancy. Radiological examination is frequently necessary not only for diagnosing pregnancy, but also for finding out the position of the foetus.

A Large Ovarian Cyst Associated with Pregnancy. The cyst occupies so much space in the abdominal cavity that the pregnant uterus is pushed laterally to one side. A soft cervix, positive internal ballotment, and breast changes are helpful signs in the diagnosis of an associated pregnancy. A large cyst should be excised to allow the pregnancy to continue unhindered and, even an accidental finding of a pregnant uterus after opening the abdomen, is not a

serious clinical mishap as the cyst has to be removed in any case.

Overdistension due to Hydramnois or Multiple Pregnancy. In an excessively overdistended uterus, the foetus cannot be palpated and foetal heart sounds may or may not be heard. Fluid thrill is usually present, and radiological evidence is most helpful as it not only detects the foetus but also some foetal abnormality which is often present in such cases.

Pseudocycsis (Spurious Pregnancy)

It is a rare condition in which the patient imagines that she is pregnant. It is usually observed in frustrated women nearing their menopause who intensely desire to have children and genuinely deceive themselves that they have at last become pregnant. The amenorrhoea of approaching menopause makes their belief stronger. It may also occur in younger women and, though in them the cyclic menstruation occurs, they yet attribute this bleeding as an associated complication of their pregnancy.

Subjective symptoms, like nausea and vomiting, occur and imaginary foetal movements are also felt by the patient which are, in fact, violent gaseous movements in the intestines. In some cases, enlargement of breasts, increased pigmentation and secretion have been observed.

The diagnosis of pseudocycsis is not difficult. To convince the relatives that the enlargement of the abdomen is not due to pregnancy, an examination under anaesthesia may be necessary. Realisation comes to them when they see the abdomen become flattened under anaesthesia. In an obese patient, it gives an opportunity to the obstetrician to perform a bimanual examination and make himself doubly sure that the uterus is not enlarged. Even after a negative biological test and even in the absence of foetal skeletal shadow on radiological examination, it is extremely difficult to convince the patient that she is not pregnant. The author had a patient who remained unconvinced and made all preparations in expectation of her offspring. She developed psychosis when the expected labour did not set in after eleven months' amenorrhoea.

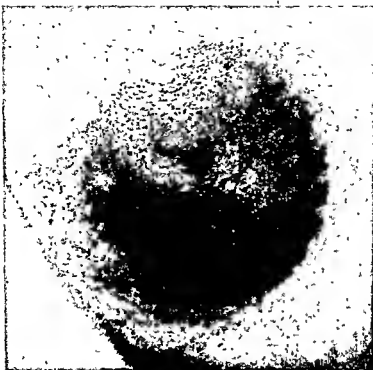
Diagnosis of Intra-uterine Death of Foetus. In the early months of pregnancy, diagnosis of the ovum having perished is frequently difficult and repeated examinations are necessary to demonstrate that the uterus has ceased to grow. The most convincing evidence is the reduction in the size of the uterus. As a rule,

the biological test becomes negative about two weeks after the death of the foetus. A positive test does not necessarily indicate that the foetus is alive as the chorion is capable of secreting chorionic gonadotrophins for three to four weeks after foetal death. The persistent amenorrhoea, after a missed abortion with an almost normal sized uterus, is, at times, treated as a secondary amenorrhoea of endocrine origin and its true nature is revealed only during a curettage.

In the later months of pregnancy, the patient frequently seeks advice for the absence of foetal movements which were formerly present. When pregnancy has advanced to beyond 24 weeks, the absence of foetal heart sounds is a strong evidence of intra-uterine death of the foetus. When intra-uterine death of the foetus has occurred recently, the size of the uterus will be as expected according to the period of amenorrhoea, and reduction in size of the uterus will be apparent after repeated weekly examinations. Regressive changes in the breasts occur, but absolute reliance cannot be placed on these changes.

Radiological evidence of intra-uterine death is obtained from: (1) *Spalding's Sign*. Within a week or ten days after intra-uterine death, the foetal skull bones overlap as a result liquefaction of the brain substance (Plate 31). (2) *Exaggerated Curvature of Foetal Spine*. This test also requires several days to develop as it depends on the maceration of the spinous ligaments. It is not as reliable a sign as Spalding's sign and should be considered as a corroborative evidence. (3) *Demonstration of gas in the foetus* may sometimes be visualised and is a strong corroborative evidence of foetal death.

Duration of Pregnancy. From basal body temperature observations, it is estimated that the duration of pregnancy, from the date of conception to term, is between 266 to 270 days. The average duration of pregnancy is about 280 days. The due date is calculated by counting nine calendar months forwards or three months backwards from the first day of the last menstrual period and adding seven days. Thus, for instance, when the first day of the last menstrual period is on 1st of January then nine months forwards would be 1st of September and by adding 7 days the approximate due date would be 8th of September. It should be remembered that wide variations occur and the duration may be as short as 260 days or as long as 300 days. These variations are due to varying lengths of cycles in women, and 280 days' calcula-



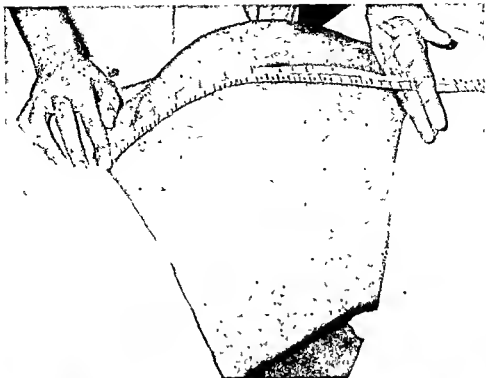
Pl-29. Dark pigmentation of areola around nipple during pregnancy (p. 70).



Pl-30. Striae gravidarum (p. 71)



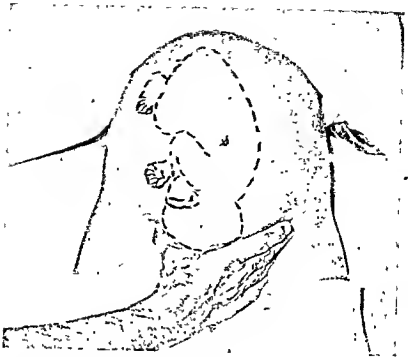
Pl-31 X-ray showing overlapping of bones of the vault of the skull
(Spalding's sign) (p 80)



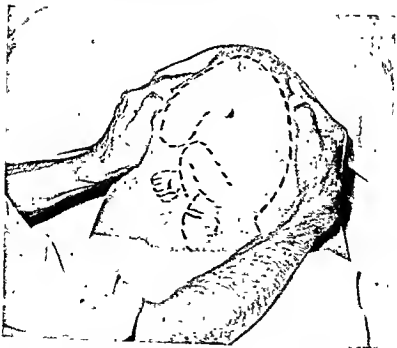
Pl-32. The measurement of fundal height (p 86)



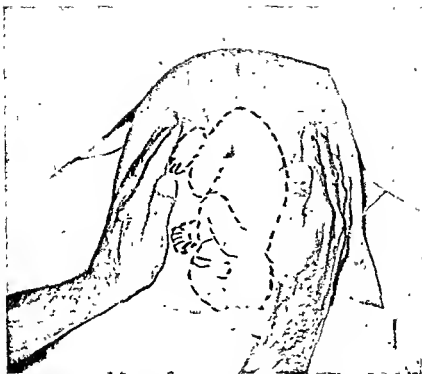
Pl-33. The measurement of girth of abdomen (p. 87).



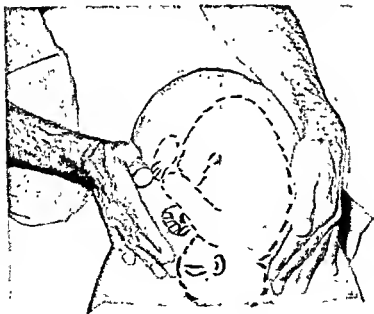
Pl-34 Palpation by Pawlick's grip (p. 87).



Pl-35. Palpation by fundal grip (p. 88).



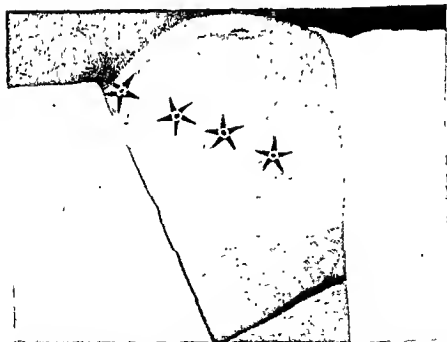
Pl-36. Palpation by lateral grip (p. 88).



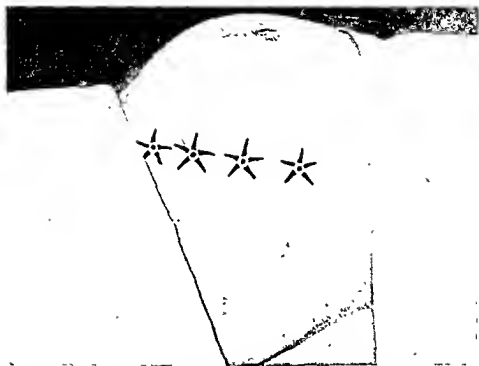
Pl-37. Palpation by second pelvic grip (deep pelvic palpation) (p. 89).



Pl-38 Positions of anterior shoulder and location of foetal heart sounds in anterior positions of the head (p. 89).



Pl-39. Positions of anterior shoulder and location of foetal heart sounds in posterior positions of the head with anterior rotation of the shoulder during labour (p. 89).



Pl-40. Positions of anterior shoulder and location of foetal heart sounds in posterior position of the head when rotation fails to occur during labour (p 89).

tion is based on a regular 28 days' cycle. As the post ovulatory period is constant between 13 and 15 days, calculation should be adjusted in shorter or longer cycles. Thus, a woman, having 40 days' cycle, would probably have ovulated about the 25th or the 27th day, and adding 270 days from the probable date of ovulation would be a more accurate calculation than the conventional one of calculating 280 days from the first day of the last menstrual period.

The duration of regnancy has considerable medico-legal importance when legitimacy is in question. There is no uniformity in the decision given by the court. English and American courts have considered legitimate birth even when pregnancy has extended over 330 days. In such cases, the date of the last coitus and the duration of the menstrual cycle in that individual form important basis in calculation. In 1959, Perr reviewed the legal literature on alleged prolongation of pregnancy.

There are circumstances when the conventional method of calculation is inapplicable and other means have to be employed. In India, prolonged lactation is common and a number of women conceive during the period of lactation amenorrhoea. Though surprising, it is still true that it is not uncommon to come across women who have no recollection of their last menstrual period. There are also instances where women do not menstruate throughout their reproductive life and, in them, calculation of the term of pregnancy cannot be arrived at in the usual way. In such cases, the patient should be instructed to make a note of the date when she first experienced 'quickening'. The date of 'quickening' experienced by a multiparae is reliable in calculation; but that recorded by primigravidae is useless as they feel the 'quickening' at a much later date due to their inexperience.

Enlargement of the uterus and the height of the fundus are usually, but not in all cases, fairly accurate in arriving at the term of pregnancy. Enlargement of the uterus can be more accurately palpated in a thin than in an obese subject. An overdistended uterus is of no value in calculating the date.

References

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CHAPTER 2

ANTENATAL CARE

Care of the expectant mother is a striking example of what can be achieved by 'preventive medicine'. Pregnancy and labour represent the highest biological function, and a pregnant woman should receive special attention. In many early civilizations, special attention was given to pregnant women. Ancient medical writings contain instructions, particularly as to their diet, their activity and the type of ointment which should be used in massaging the abdomen to prevent striae gravidarum. These early teachings were forgotten until the end of the nineteenth century when, in 1892, Professor Budin introduced antenatal care in Charite Hospital, Paris, primarily to check the falling birth rate in France. In the British Isles, Ballantyne was the pioneer to start prenatal care in Edinburgh. Antenatal supervision was first introduced in India in the obstetric institutions of large cities in the early thirties of this century.

The chief objectives of adequate antenatal supervision are to reduce (1) maternal mortality, (2) maternal morbidity, (3) perinatal mortality, and (4) morbidity in the newborn. Besides these, it has helped in establishing a doctor-patient relationship, which has helped the obstetrician to gain the confidence of his patients. By proper orientation of the physiology of pregnancy and the processes of labour, the patient is reassured. Primigravidae are apprehensive because of the 'fear of the unknown' and are, particularly, in need of a certain amount of reassurance.

The benefits of antenatal care are reflected in the reduction in maternal, and perinatal mortality. Best results are obtained where a prenatal clinic is a part of a well equipped maternity institution, so that continuous supervision by the same medical personnel during pregnancy, labour, and the post natal period, is available.

A *gravida* is a pregnant woman. Thus, a *primigravida* is one pregnant for the first time, *secundigravida* is one who is pregnant for the second time, and a *multigravida* is one who has been pregnant several times.

The term *para* refers to past pregnancies which have reached viability. Thus, a *primipara* is one who has delivered one viable

child. A multipara is a woman who has had two or more viable childbirths.

To clarify, a woman may have become pregnant three times but, if only one of the conceptions has been carried to full term, she is a *third gravida* but a *primipara*.

The terms, *gravida* and *para*, refer to pregnancies and not to foetuses. Thus, a woman who delivers twins at the end of her first pregnancy, is still a *primipara*.

A properly conducted antenatal examination consists of: (1) history, (2) general and systemic examination, (3) obstetric examination, (4) laboratory tests and radiological examination, and (5) instructions to the patient.

History. The name and address of the patient, her occupation, age and parity are recorded. The expected date of delivery is calculated from the date of the last menstrual period. In cases where the patient does not recollect the date of her last menstrual period, or when she has conceived during the period of lactation amenorrhoea, the date of quickening, which is approximately at 18 weeks, is sought, and from that date the expected date of labour is calculated.

Family History. Multiple pregnancy has familial tendency. History of tuberculosis in the family should always be inquired into. Allergic and hereditary diseases in the family should be recorded.

Past Illnesses. Past history of rheumatic fever is important, as 90 per cent of cardiac lesions result from it. History of active or healed tuberculous lesion is significant, as pregnancy may aggravate or flare up the focus. Rickets, osteomalacia, affections of the spinal column or the hip joints, often distort the shape of the pelvis. Toxaemia in a previous pregnancy should always be inquired.

Past Obstetric History. It should be emphasized that past obstetric history is best recorded in chronological order of the past pregnancies. Knowledge about previous pregnancies, labours and puerpera, is indispensable. Certain complications are likely to recur in a subsequent pregnancy or labour. Some of these complications are preventable, while others are better managed if anticipated.

Complications likely to recur in a subsequent pregnancy are: habitual (recurrent) abortions, cardiac decompensation, pre-

eclamptic toxæmia or eclampsia, premature labour, Rh incompatibility and intra-uterine death of the foetus.

Previous labours are to be regarded as normal when babies weighing 6 pounds or more were spontaneously delivered within 24 hours of the onset of labour. Previous stillbirths, after prolonged labours or forceps deliveries, suggest cephalopelvic disproportion. Death of the foetus, shortly after an apparently normal labour, indicates intracranial injury from excessive moulding. Cephalopelvic disproportion, malpresentation, malposition of the head, cord prolapse and rupture of the uterus are some of the complications likely to recur in a subsequent labour.

A history of rise of temperature for several days during the puerperium, secondary post partum hæmorrhage, infection of the perineal wound or the breasts may be obtained.

History of Present Pregnancy. In the early months, nausea, vomiting, and frequency of micturition usually occur and readily respond to treatment. Difficulty during micturition or retention of urine occurs about the 12th to 14th week, when a retroverted gravid uterus gets incarcerated in the pelvic cavity. Excessive vomiting, oedema and evidence of toxicity suggest a molar pregnancy.

In later months, slight oedema of the feet normally occurs in many women. Marked oedema occurs in toxæmias, hypoproteinaemia, severe anaemia, decompensated cardiac disease, and chronic nephritis. Besides oedema, other symptoms of toxæmia, such as persistent headache, oliguria, epigastric pain and visual disturbances, should always be inquired into. Ordinarily breathlessness is commonly due to flatulence and constipation, but breathlessness on exertion, cough and precordial pain occur in decompensated cardiac disease. Profuse, curdy or watery vaginal discharge, associated with pruritus, is due to monilial or trichomonal infection of the vagina. Cramps in the lower limbs is a common accompaniment of later months of pregnancy. Heart burn is also a common symptom. Sleeplessness is a troublesome feature in some cases.

General and Systemic Examination. No doubt, the detection and prompt treatment of obstetric complications, like malpresentations and toxæmia of pregnancy, are an important aspect of antenatal care. But it cannot be overemphasized that medical disorders, like anaemia, heart disease, diabetes, etc. during pregnancy, deserve an equally important attention. It is, therefore, a pity that, to most students, many practitioners and some of the residents, antenatal supervision begins and ends with palpation of the foetus

and auscultation of the foetal heart sounds. A casual and cursory antenatal examination is worse than useless in as much as it gives the patient a false sense of security.

The patient should be weighed at each visit. Excessive gain in weight, particularly in the last trimester, is usually due to oedema and is significant of impending pre-eclamptic toxæmia. The average weight gain after the 24th week is half kg. (one pound) per week.

Nutritional anaemia is so common in the low income group that the evidence of anaemia should be the first thing to observe in the general appearance of the patient. Irrespective of clinical evidence of anaemia, a blood examination must be done at the first visit and repeated as often as is necessary. The average haemoglobin percentage in non-pregnant Indian women is usually between 70 to 80 per cent, but, during pregnancy due to hydraemia of the blood, 65 per cent is considered as normal, and below 60 per cent is considered as anaemia. Red blood cell count below 3 millions indicates anaemia. ABO and Rh-grouping of the blood should be determined.

The blood pressure must be recorded at each visit as it is often the first evidence of impending pre-eclamptic toxæmia. The average blood pressure reading of Indian women in the non-pregnant state is 100-110 systolic and 70-80 diastolic. During pregnancy, a rise of systolic pressure above 130 and diastolic above 90 should be considered as abnormal. It should be noted that at the first visit, due to emotional excitement, the systolic blood pressure often rises above 130, but as long as diastolic pressure remains normal, it is not clinically significant.

The urine should be examined at each visit for the presence of albumin. Test for sugar in the urine should be done once in each of the three trimesters.

A routine examination of the respiratory and circulatory systems must be made at the first visit. A fully compensated congenital or acquired valvular disease may thus be accidentally detected. Similarly, an early tubercular focus, asthma or other pulmonary conditions are thus diagnosed. The breasts are inspected at the same time, particularly for the shape and size of the nipples. If the nipples are protruding, the patient should be advised to apply olive oil every night. If the nipples are depressed, she should be asked to make attempts to pull the nipples out by manipulation.

The teeth and the throat should be examined for evidence of a septic focus.

Obstetric Examination. If the patient is seen before the 12th week of pregnancy, a vaginal examination is necessary to confirm pregnancy. Should a retroflexed gravid uterus be detected, it should be left alone, as it nearly always corrects itself.

Before 28 weeks of gestation, abdominal palpation of the foetus for presentation and position is not clinically significant as the small foetus frequently changes its position. A breech or an oblique lie of the foetus after 30th week should be corrected by external version. As spontaneous version occurs in a number of cases after the 34th week, it is usual to delay version until that time. It is our practice to perform version at 30 weeks or thereafter as soon as an abnormal lie is diagnosed, because version is easy while the foetus is comparatively small. In cases of breech with extended legs, version frequently fails when attempted at 34 weeks, while it is usually successful when performed earlier.

Fundal Height. The fundus is palpable just above the symphysis pubis at 13 weeks, and reaches the umbilicus at 24 weeks. The duration of pregnancy between these two periods is roughly calculated by dividing the distance between the symphysis pubis and the umbilicus into three equal parts. At sixteen weeks, the fundus is one-third the distance, and at twenty weeks, two-third the distance above the symphysis pubis. Similarly, the distance between the umbilicus and the xiphisternum is divided into three equal parts. At 28 weeks, it is one-third the distance, and at 32 weeks, two-third the distance above the umbilicus. At 36 weeks, the fundus is just below the xiphisternum. With the engagement of the presenting part in the last weeks of pregnancy, the height of the fundus at term is at a lower level than at 36 weeks (Fig. 15).

For accurately measuring the height of the fundus, the bladder should be empty. If the uterus is deviated to one side, it should be brought in the midline. One end of a measuring tape is placed at the upper border of the symphysis pubis and the height measured as shown in Plate 32. It is preferably measured in centimetres or, if taken in inches, it is converted into centimetres by multiplying the height in inches by 2.5. To obtain the approximate duration of pregnancy in months, the height in centimetres is multiplied by 2 and divided by 7. Thus, a fundal height of 12 inches, when converted into centimetres (12×2.5) becomes 30 cm.; when multiplied by 2 this becomes 60, and divided by 7, calculates approxi-

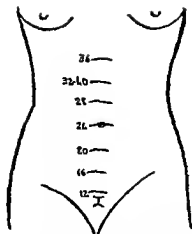


Fig. 15. Fundal height at different weeks of pregnancy.

mately to 8½ months. An easy way to remember is that, after the sixth month, twice the fundal height in centimetres is in multiples of 7. That is 49 at 7 months, 56 at eight months, and 63 at nine months.

The *girth of the abdomen* is measured by passing a tape round the abdomen at the level of the umbilicus. The average measurement at full term is between 82 and 87 cm. (32 and 35 inches) (Plate 33).

Palpation of Foetus. The patient is examined in the dorsal position with the knees slightly bent. The abdomen is completely uncovered. The parts of the foetus which can be separately identified are the head, the breech, the back, the limbs and the anterior shoulder. As the lie of the foetus is vertical in more than 95 per cent of the cases and, since the head of the foetus lies in the lower pole of the uterus in 97 per cent of the cases of vertical lie, it is best to palpate the lower pole of the uterus (first pelvic palpation) followed by palpation of the fundus (fundal palpation), and then the back and the limbs (lateral palpation). Finally, the attitude of the head, its position in relation to the pelvic brim and the anterior shoulder is palpated by the *second pelvic grip*.

Pawlick's Grip (First Pelvic Palpation). Standing on the right side of the patient and facing her, the ulnar border of the right hand is placed along the left Pouparts' ligament and the outstretched thumb along the right Pouparts' ligament. A wide grip of the lower pole is thus obtained. The head is palpated as a smooth, round, hard mass which can be ballotted from side to side. Ballotment is most important for confirming the head (Plate 34). When

the head is above the pelvic brim, it is freely ballotted and is termed 'floating,' when a part of the head has entered the brim, the head is said to be *engaging*, and limited ballottment is possible. When the biparietal diameter of the head has gone below the pelvic brim, the head cannot be ballotted, and is said to be *engaged*.

Fundal Palpation. The fundus of the uterus is next palpated. The position of the person examining the patient remains as for the Pawlick's grip. The fundus is broad and is palpated with two hands laid flat upon it. The breech is felt as a large, firm, irregular mass which is not ballottable as it is continuous with the trunk. In breech presentation, the head is at the fundus, and is more often on one or the other side and, less frequently, in the centre of the fundus. Therefore, it is necessary to palpate the fundus in three separate areas, viz. near the two costal arches and in the centre, to exclude the presence of head at any of these sites at the fundus (Plate 35).

Lateral Palpation. The sides of the uterus are next palpated by placing the palm flat on either side of the uterus. On the side of the back, a smooth rounded continuous area is palpated. On the opposite side, irregularities or definite knobs, which frequently move away during palpation, are palpated. The back is easily and distinctly palpated in occipito anterior positions, but frequently, not so in occipito posterior positions. In anterior positions of the occiput, the irregularities of the limbs are palpated on the side opposite to that of the back, and well away from the midline: In occipito posterior positions, the limbs are palpated, not only on the opposite side but also in the midline, and for some distance on the same side as the back. It will be observed that the anterior abdominal wall is convex and dome shaped in anterior positions, and is flat in posterior positions (Plate 36).

Deep Pelvic Palpation (Second Pelvic Grip). The person examining the patient stands on the right side facing her feet. The hands are placed flat on either side of the lower part of the abdomen. The head is felt and ballotted by the two hands; thus the presence or the absence of the foetal head is once again confirmed. The position of the presenting part in relation to the pelvic brim is again checked to observe whether it is floating, engaging, or engaged, by trying to reach the lowest part of the head.

The attitude of the head is next determined by placing the finger tips of one hand on the occipital prominence which is on the same side as the back, and placing, on the other side, the finger

tips of the other hand on the sinciput. It will be obvious that when the head is well flexed, the occipital prominence is at a lower level than the sinciput. When the head is partly deflexed, the occipital prominence and the sinciput are at the same level. In fully extended positions of the head, the sinciput will be at a lower level than the occipital prominence (Plate 37).

Anterior Shoulder. The position of the anterior shoulder is located by slowly sliding the finger tips upwards from the head until the groove of the neck is palpated. By further upward movement of the fingers, a well-marked prominence on the same side as the back just above the neck, is palpated, and this is the anterior shoulder. An alternative method is to trace the back from the fundus downwards. The knobby projection at its lower end is the anterior shoulder. The position of the anterior shoulder is about $1\frac{1}{2}$ inches from the midline in anterior positions of the back, and about $3\frac{1}{2}$ inches away from the midline in posterior positions of the back. The height of the anterior shoulder, from the upper border of the symphysis pubis, is $4\frac{1}{2}$ inches or more when the head is floating, between 3 to 4 inches when the head is engaging, and $1\frac{1}{2}$ inches when the head is deeply engaged (Plates 38, 39, 40).

Auscultation of Foetal Heart. At each visit, the foetal heart sounds must be auscultated. Due to the limbs being folded over the foetal chest, the heart sounds are not clearly audible over the precordial region of the foetus. They are easily audible on the same side as the back in the interscapular region. As the interscapular region is close to the anterior shoulder, the stethoscope, placed just above and lateral to the anterior shoulder, readily locates the sounds.

In cephalic presentations, the heart sounds are audible in the lower abdomen. In anterior positions, they are heard best about $1\frac{1}{2}$ inches away from the midline. In posterior positions they are heard 3 to 4 inches away from the midline or even as far out as in the flanks. Their distance from the symphysis pubis depends on the position of the head in relation to the pelvic brim.

In posterior positions of the back, the heart sounds are audible in the flanks on the same side as the back but due to the extension of the foetal spine, the precordial region is close to the abdominal wall and the heart sounds are also audible on the side opposite to the back. The inexperienced frequently depend on diagnosing the position of the foetus from the position of the heart sounds, and mistake the posterior position for the anterior position of the

opposite side. Thus, a right occipito posterior position will be mistakenly diagnosed as left anterior position by hearing the heart sounds in the left anterior quadrants.

In breech presentations, the heart sounds are heard at the level of the umbilicus or above it, depending on the position of the back, the term of pregnancy, and the position of the breech in relation to the pelvic brim. In breech presentation with extended legs, they are heard at a relatively low level, because the conical breech engages into the pelvic cavity several weeks before full term.

The position of the heart sounds in oblique and transverse lie is variable.

The rate of the foetal heart sounds during pregnancy is more or less constant, varying from 120 to 140 per minute.

Funic Soufflé. It is a blowing sound, synchronous with the foetal heart rate. It is heard in about 15 per cent of the cases. It has no obstetric significance but, when heard, it is a positive sign of pregnancy. It was first described by Kennedy in 1847 in "Observations On Obstetric Auscultation". The commonest site of production is in the umbilical vein, at any point in the cord at which the flow of blood is obstructed.


Uterine Soufflé. It is due to the passage of blood through the dilated maternal vessels. It is heard as a soft blowing sound, synchronous with the maternal pulse.

Clinical Pelvimetry. The size of the pelvis is estimated by taking external measurements and also by a vaginal examination. The external measurements give a rough estimate of the internal measurements of the brim. At the outlet, however, external measurements give a fairly accurate width of the transverse and antero-posterior diameters. Clinical pelvimetry is described in the chapter on contracted pelvis.

Vaginal Examination. A vaginal examination to assess the size of the bony pelvis, should be done during one of the antenatal visits. In an occasional case, the presence of a pelvic tumour will be detected on vaginal examination. It is easier to assay the size of the pelvis in multigravidae than in primigravidae. As pregnancy advances, there is a softening of the pelvic tissues which makes assessment easier.

The index and the middle fingers are placed in the vagina and pressed upwards and backwards to reach the promontory. The *diagonal conjugate* is the distance from the centre of the lower border of the symphysis pubis to the central point of the promon-

tory of the sacrum. In a normal sized pelvis, the promontory cannot be reached. When a bony point is reached, it might be the promontory or the first sacral ridge. In the case of the promontory, when the finger is pressed further upward, the bone recedes and passes out of reach, whereas the finger passed beyond the sacral ridge is still in contact with the bone. When the promontory is reached, the diagonal conjugate is measured by marking off the point where the lower border of the symphysis pubis comes in contact with the forefinger. The hand is withdrawn, and the distance between this point and the tip of the middle finger is measured. By deducting $\frac{1}{2}$ inch for the thickness of the symphysis, the diagonal conjugate is obtained.

The inclination and the curvature of the sacrum is assayed. Normally, the ileo-pectineal lines are felt far out laterally, having a broad curve. The side walls of the pelvis are concave in a gynaecoid pelvis, but in the android type the side walls are relatively less curved. The width of the sacro-sciatic notch is estimated. A broad notch is more than two fingers wide. Next, the ischial spines are palpated. Curving in of the tips of the ischial spines indicates a narrow mid-pelvic plane. The symphysis pubis should have a flat surface, and 'beaking' of the pelvic surface indicates an osteomalacic pelvis. The width of the pubic arch is estimated as the fingers are being withdrawn. It is important to note whether the sub-pubic angle forms a wide arch (Norman arch) or the sub-pubic angle is acute (Gothic arch). A 'Norman' pubic arch is more favourable than a 'Gothic' arch. 

CHAPTER 3

HYGIENE OF PREGNANCY

Diet. A woman accustomed to a balanced diet does not need much alteration in her diet during pregnancy. The pregnant woman should be advised against following advice of friends and relatives based on mistaken notions. The first wrong notion is that a pregnant woman should eat more because she has to eat for two; and the second is the opposite that she should eat less as otherwise her baby will become too large. As to the first, it is important for her to consume selected foodstuffs to maintain her nutrition. Concerning the second, it should be impressed that birth weight is a genetic factor and does not depend on the quantity of food she consumes.

Generally speaking, foodstuffs are grouped into two categories. The first group has an "essential" food value and consists of articles which are necessary for growth and replacement of daily wear and tear. Proteins, vitamins and minerals form this group. The second group, the "energy" giving foodstuffs, have the value of maintaining body heat and supplying calories for work. These consist of foods rich in carbohydrates and, to a small extent, fats. The total caloric value should be about 2,500 calories a day.

Proteins. During pregnancy, there is an increased demand for proteins as, besides her normal needs, proteins are required for foetal growth, the growth of the uterus and for increased volume of plasma proteins. The average intake of 60 gm. of proteins during the non-pregnant state needs to be increased to 85 gm. As all the essential amino acids are present in animal proteins, it is advisable that atleast two-thirds of the protein requirements should be of animal origin, such as milk and milk proteins, meat, eggs and fish. The remaining protein requirements may be of vegetable origin and can be derived from whole wheat, unpolished rice, peas and beans.

The depletion of plasma proteins, as a result of inadequate protein intake, reverses the balance of osmotic pressure and fluid is drawn into the extracellular tissue causing oedema. It is not definite but is probable, that inadequate protein intake is a factor in producing toxæmia of pregnancy.

Vitamins. The importance of vitamin-rich diet in pregnancy is self-evident. Vitamin A increases resistance to infection and is important to prevent infection during pregnancy, labour and puerperium. Milk and milk products, carrots, green leafy vegetables and yellow fruits contain vitamin A. Besides vitamin intake in foodstuffs, it is necessary to supplement daily 5000-10000 I.U. of vitamin A.

All the vitamin B fractions are essential for proper nutrition. Deficiency of pyridoxine, B₆, is particularly observed in the early months, giving rise to excessive nausea and vomiting.

Deficiency of thiamine, B₁, is common during pregnancy due to the demands of the foetus. Its milder manifestations are cramps in the extremities; and a greater deficiency may lead to polyneuritis. As thiamine is destroyed during the process of cooking, a liberal supplement is necessary.

Vitamin C is essential for normal iron absorption. Its deficiency causes spongy gums and its absence results in scurvy. Citrus fruits and tomatoes are rich in vitamin C and the diet should contain adequate amounts of citrus fruits and tomatoes.

Vitamin D plays a part in maintaining calcium and phosphorus metabolism. The ordinary diet does not supply sufficient vitamin D and 400-800 I.U. should be supplemented daily.

Vitamin E (α -tocopherol) is believed to be important in sustaining pregnancy and its deficiency is regarded as a cause of abortion.

Vitamin K should be supplemented at term so as to build up a reserve in the newborn.

Minerals. The important mineral elements for human nutrition are calcium, phosphorus, iron, sodium and potassium. When these are present in adequate quantities in the diet, the other elements, such as cobalt, manganese, etc. are also present in sufficient quantities.

The demands for calcium are greatest during the last four weeks of pregnancy and, therefore, it is essential that maternal storage during the earlier months should be adequate to meet this sudden foetal need. The calcium contents of the foetus at term is about 25 gm. Foods rich in calcium are milk, eggs and some vegetables. About a pint of milk a day and a couple of eggs, supplemented by calcium gluconate tablets orally, would be sufficient for the needs of pregnancy.

Phosphorus is required in moderate amounts and is present in

good quantity in milk, eggs and fish. However, too much phosphorus tends to depress the diffusible serum calcium levels and, therefore, large quantity of milk is likely to have an opposite effect and symptoms of calcium deficiency, such as cramps, may occur.

The metabolism of iron has been already described but it needs to be stressed that iron contained in an average balanced diet is not sufficient to meet the increased demands of the foetus and adequate supplement of medicinal iron is necessary. Only ferrous salts are absorbed and, for normal absorption, certain amino acids and vitamin C are necessary.

From the above discussion of dietary requirements of a pregnant woman, a balanced non-vegetarian and vegetarian diet should include the following foodstuffs.

Non-vegetarian Diet. Daily diet should consist of one-half to three-fourths of a pint of milk, four ounces of fish or meat, a couple of eggs, an ounce of butter, green leafy vegetables, two tomatoes, and two oranges or sweet limes.

Vegetarian Diet. One and a half pint of milk or milk products, whole wheat bread, other cereals, large quantities of green leafy vegetables, two tomatoes and two oranges or sweet limes.

In both forms of diet, medicinal supplement of calcium, iron and vitamins is necessary.

Exercise. In addition to attending her housework, a certain amount of exercise in the fresh air is desirable. The best form of exercise is walking on a level road. Besides increasing muscular tone, walking in fresh air and among pleasant surroundings diverts the mind and has therefore, a psychosomatic value. The walk should be only as much as can be borne without getting fatigued. Strenuous forms of exercise should be discouraged, as it may lead to abortion in the early months and to premature labour in the last six to eight weeks of pregnancy.

Besides walking, a woman who is used to playing games, such as tennis, badminton, etc., should be allowed to continue these games from 14th to 32nd week but should be advised not to play as strenuously as she used to in the non-pregnant state.

Deep breathing and other exercises aiming at relaxing the body musculature have the additional value of producing relaxation during labour.

Clothing. During the early weeks of pregnancy, the attire need not be different from the non-pregnant state but, after the sixteenth

week and thereafter, the garments should be such as not to constrict the waist. In India, saree is an easily adjustable form of dress. For those accustomed to European dress, especially tailored garments, which fit loosely round the waist and which can be removed or put on without much effort, are available.

During pregnancy, low heeled shoes are advisable. High heeled shoes increase the lordosis and often lead to backache. Besides, low beeled well-fitting shoes maintain a good balance and firm footing.

Sexual Intercourse During Pregnancy. All conceptions until after the formation of the placenta, that is, up to 12 to 14 weeks, are rather unstable and any form of excitement, sexual, emotional or physical, is likely to cause abortion. Vigorous coitus during these weeks is likely to cause uterine contractions of such intensity as to start the process of abortion. Clinical evidence is in support and, therefore, advice should be given against indulging in coitus for the first four months of pregnancy.

After the sixteenth week, coitus should be allowed until such term as when the discomfort to the woman makes it unpleasant. Coitus should be avoided during the last six weeks of pregnancy.

Care of Teeth and Gums. Teeth and gums should be inspected during prenatal supervision. There should be no hesitation in extracting carious teeth, filling cavities and undertaking any other form of dental care that may be necessary. Those complaining of spongy gums or brittleness of teeth enamel require large doses of calcium and vitamin C.

Constipation. There is a tendency to constipation due to diminished physical exercise, hypomotility of the bowels, and in the latter part of pregnancy, the pressure of the uterus on the intestines.

A pregnant woman should therefore be advised to drink good quantities of fluid, eat plenty of green leafy vegetables, and take reasonable physical exercise. If necessary, mild aperients, like milk of magnesia, prune juices and laxatives are prescribed. But strong purgatives and enemas should be avoided.

Travel. Clinical experience is that travel, regardless of distance and type of conveyance, has no deleterious effect. However, travelling in the last weeks of pregnancy should be avoided. Women prone to abort should not undertake journeys in the earlier months of pregnancy. In any case, long journeys, and strenuous travels should be avoided as far as possible. Car driving, during the half of pregnancy, is not advisable, as sudden 'braking' is likely to

cause trauma to the abdomen from the sudden impact of the steering wheel.

Douches. Douching should be avoided during pregnancy for fear of air embolism.

Care of Breasts. Loose fitting breast supports are necessary. Progressive enlargement of the breasts stretches the mammary skin, and disfiguring striae are likely to develop. In order to keep the mammary skin soft and elastic, daily oil massage is beneficial. The nipples are prepared for lactation by daily oil massage. In warm tropical climates, application of spirit to the nipples is not advocated.

SECTION IV

NORMAL LABOUR

CHAPTER 1

OBSTETRIC PELVIS

The pelvic girdle is formed by the articulation of the two innominate bones, with the sacrum behind and with each other in front at the symphysis pubis. The pelvic girdle is divided into a "false" and a "true" pelvis. The part above the pelvic brim is known as the "false" pelvis and the part below the brim as the "true" pelvis. The false pelvis has no obstetric importance and does not require further consideration. The true pelvis is divided into three parts: the brim, the outlet and the pelvic cavity.

Brim

The anatomical boundaries of the pelvic brim can be traced from the centre of the sacral promontory to the ala of the sacrum and from there to the sacro-iliac joint, the ilio-pectineal line, the ilio-pectineal eminence, the pubic spine, the pubic crest and the centre of the upper border of the symphysis pubis.

Inclination. It is important to remember that the pelvic brim in the standing position is not horizontal, but is inclined to the horizontal at an angle of 55° , the promontory of the sacrum being approximately 9 cm. above the upper border of the symphysis pubis (Fig. 16).

Axis of Brim. It is an imaginary line drawn perpendicular to the plane of the brim at its centre. When this line is extended upwards, it passes through the umbilicus, and its extension downwards passes through the tip of the coccyx. The axis indicates the direction in which the foetus descends through the pelvic brim.

The four diameters of the pelvic brim having obstetric significance are: the antero-posterior, the transverse, and the two oblique diameters.

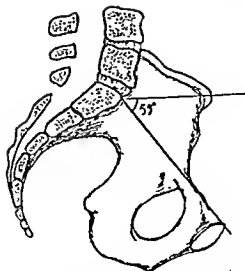


Fig. 16. A bisected pelvis showing the inclination of the pelvic brim; as in erect position.

The antero posterior diameter of the brim, true or obstetric conjugate, is measured from the centre of the sacral promontory behind to the point nearest to the promontory on the posterior surface of the symphysis pubis.

The transverse diameter is the widest distance between the ilio-pectineal lines.

The two oblique diameters are measured from the sacro-iliac articulation behind to the ilio-pectineal eminence of the opposite side. The right oblique is the diameter measured from the right sacro-iliac articulation, and the left is that measured from the left sacro-iliac articulation (Fig. 17).



Fig. 17. Female pelvis showing the diameters of pelvic brim. 1, antero-posterior; 2, transverse; 3, oblique; 4, between iliac crests; 5, between anterior superior iliac spines.

For obstetric purposes, the pelvic brim is divided into an anterior and a posterior segment at the widest transverse diameter. The anterior segment is like a triangle with its base formed by the transverse diameter. The sides consist of the ilio-pectineal line. The sides form an angle of varying size at the symphysis pubis. The capacity of the anterior segment depends on the length and the curvature of the pubo-iliac bones and on the size of the angle formed by these lateral boundaries at the symphysis (Fig. 18).



Fig. 18. Female pelvis showing the division of pelvic brim into an anterior and a posterior segments.

The posterior segment is formed by the widest transverse diameter in front, laterally by the mid-portion of the ilium which forms the summit of the greater sacrosciatic notch and posteriorly by the sacrum. The capacity of the posterior segment is variable and depends on the length of the posterior iliac portion, the size of the sacrosciatic notch, and the size, curvature and inclination of the sacrum.

Outlet

The boundaries of the anatomical outlet are the lower border of the symphysis pubis, the pubic arch, the pubic rami upto the ischial tuberosities, and from there along the greater and lesser sacrosciatic ligaments to the tip of the coccyx. These boundaries do not lie in a single plane but form two triangular planes at an angle having a common base which is the line joining the ischial tuberosities. The anterior triangular plane has its apex at the pubic arch; and the apex of the posterior triangular plane is at the tip of the coccyx.

It is evident that the outlet has lateral walls. The anterior wall is defective at the pubic arch. The posterior wall includes the tip of the sacrum and the coccyx. The important considerations of the

outlet, from the obstetric point of view, are the width of the pubic arch, the antero posterior diameter, the bituberous diameter, and the posterior sagittal diameter of Klein (Fig. 19).

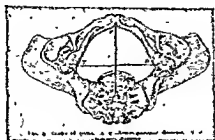


Fig. 19. Outlet of pelvis. A.P., antero-posterior diameter; T. R., transverse diameter.

Pubic Arch. The pubic arch is rounded, Norman type as in the gynaecoid pelvis, or is angular, Gothic type as in the android type. The angle of the arch varies from 100° in the typical gynaecoid pelvis to as small as 65° in the extreme android type of pelvis (Fig. 20).



Fig. 20. Two variations in shape of sub-pubic arch. A, wide angle (Norman type); B, narrow angle (Gothic type).

The obstetric significance of the shape of the pubic arch is that, when the arch is narrow, a considerable part of the antero posterior diameter is wasted. In such a case, the difficulty in the delivery of the head will depend on the size of the posterior sagittal diameter of Klein.

Antero Posterior Diameter. It is the distance from the centre of the lower border of the symphysis pubis to the tip of the last sacral vertebra. The length of the antero posterior diameter will vary according to the forward or the backward tilting of the sacrum. As mentioned before, the obstetric utilisation will also depend on the shape of the pubic arch.

Bituberous Diameter. The width of this diameter is determined by the width of the pubic arch and the length of the pubic rami. In the gynaecoid pelvis with a wide Norman arch, the distance is

greater than in the android type of pelvis having a narrow Gothic arch. Average clinical measurement is 9 to 11 cm. The length of the bituberous diameter, by itself, may be misleading, unless the pubic angle is taken into consideration.

Posterior Sagittal Diameter. It is the distance from the midpoint of the bituberous diameter to the tip of the sacrum. The length of the posterior sagittal diameter depends on the inclination of the sacrum. The obstetric significance of this diameter is that in the android type of pelvis the pubic arch is narrow and the space in the anterior triangular plane of the outlet is reduced. In such a case, the head of the foetus, during labour, is pushed backward and, should the posterior sagittal space be also reduced due to the forward tilting of the lower part of the sacrum, difficulty in delivery at the outlet is certain to occur. A straight sacrum may increase the posterior sagittal diameter beyond average dimensions.

Pelvic Cavity

The pelvic cavity has a shallow anterior and a deep posterior wall. The anterior wall, formed by the symphysis pubis, is about 3.75 cm. in length, while the posterior wall, extending from the sacral promontory to the tip of the sacrum, is about 11.25 cm. in length. The lateral walls measure about 7.5 cm.

The size of the cavity depends on the curvature of the sacrum and on the straight or sloping side walls. Though a number of planes can be described at different levels, only two planes are of obstetric significance: (1) The midplane, the roomiest plane, and (2) the narrow pelvic plane (Fig. 21).

Midplane. It is bounded in front by the centre of the pubic surface of the symphysis pubis and behind by the junction of the second with the third sacral vertebrae. It is the roomiest part of the pelvis in all types of pelvis.

Narrow Pelvic Plane. It is bounded anteriorly by the midpoint of the lower border of the posterior surface of the symphysis pubis, laterally by the tips of the ischial spines, and posteriorly by the tip of the sacrum. It is the plane of the least pelvic measurements.

The important diameters from the obstetric point of view are: the antero posterior, the bispinous and the posterior sagittal which is the distance from the midpoint of the bispinous diameter to the sacrum. The length of the posterior sagittal diameter depends on

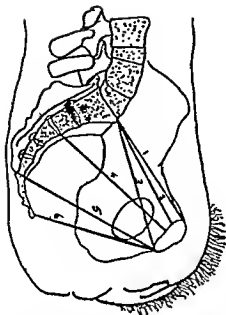


Fig. 21. Diagram showing pelvic planes. 1, conjugata vera; 2, obstetrical conjugate; 3, diagonal conjugate; 4, plane of greatest pelvic dimensions; 5, plane of least pelvic dimensions; 6, antero-posterior diameter of pelvic outlet.

the curvature of the sacrum. When the diameter is long, it indicates a nicely curved sacrum and there is useful available space posteriorly.

This plane corresponds to the site of origin of the levator ani muscles and marks the beginning of the forward curve of the pelvic axis. It is at this plane that internal rotation occurs. The length of the bispinous and the posterior sagittal diameters influence the rotation of the head in front or behind. When the bispinous diameter lies far back, enough room is available anteriorly for rotation in front. A relatively short bispinous diameter and a long posterior sagittal diameter favour posterior rotation. The average bispinous diameter is 10.5 cm. In Indian women, the length of the bispinous diameter is often 9.5 cm. but, owing to smaller birth weight of the infants, normal delivery is usually possible.

CHAPTER 2

FOETUS

In order to understand the mechanism of the passage of the foetus through the pelvis, it is necessary to consider: (1) how the foetus is accommodated in the uterus, and (2) the diameters of the foetal skull engaging in different cephalic presentations, the bis-acromial diameter across the shoulders, and the bi-trochanteric diameter across the hips.

Before the 28th week of pregnancy, there is relatively more room in the uterus for the foetus to move, so that the foetus frequently changes its position; but, during the last few weeks of pregnancy, the foetus is cramped up and accommodates itself by folding itself up as much as possible. Its movements being thus restricted, it is unlikely to change its position.

Lie of Foetus. The position of the foetus in relation to the long axis of the uterus is defined as the lie of the foetus. In about 99 per cent of the cases, the lie is longitudinal corresponding to the long axis of the uterus, the head being in the lower pole of the uterus in about 96 per cent of the cases, and the breech occupying the lower pole in 3 per cent. In less than 1 per cent, the foetus in utero lies obliquely or transversely. It is evident that for the foetus to pass through the pelvis, the lie must be longitudinal. An oblique or transverse lie is dangerous and, when left uncorrected, leads to an obstructed labour (Fig. 22).

Attitude of Foetus. The manner in which the foetus accommodates itself in the uterus is known as the attitude of the foetus. Generally, the attitude is that of flexion of the trunk and the limbs. The head is flexed so that the chin is approximated to the chest wall; the spine is flexed so that the back becomes curved; the forearms are flexed and crossed across the chest wall; the thighs are fully flexed on the abdomen; the knees are flexed and the legs are crossed at the ankles. This attitude of flexion is due to the fact that the flexor muscles have a greater tone than the extensor muscles (Fig. 22). It should be noted that the exaggerated attitude of flexion observed in frozen sections is not present in the living foetus with the liquor amnii all around it. The tonus of the uterus increases towards term and during labour, and exaggerates the attitude



Fig. 22. Normal attitude of flexion of foetus.

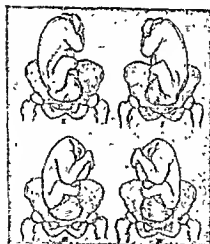


Fig. 23. Four positions of the foetus in vertex presentations.

of flexion. Moreover, direct pressure of the uterine wall after the rupture of the membranes increases the flexed attitude of the foetus.

When the head is at the lower pole of the uterus, the broad breech occupies the relatively broad area at the fundus and the foetal ovoid fits well in the long axis of the uterus. When the

breech occupies the lower pole, the broad end of the foetal ovoid occupies the relatively narrow lower pole of the uterus and does not fit into it as well as the head. In those cases of breech, however, where the legs are extended, the narrow conical breech fits in the lower pole as well as the head.

Presentation of Foetus. The word *presentation* is applied to define that part of the foetus which lies over the pelvic brim. Thus, when the head lies over the pelvic brim, it is known as cephalic presentation and, when the breech occupies the lower pole, it is known as breech presentation.

The position of the foetus is defined according to the situation of the back. The back may be to the left or to the right side of the mother and, in either case, it may lie anteriorly against the anterior abdominal wall or posteriorly in the flanks. Accordingly, there are four positions of the foetus: (1) back to the left and in front, (2) back to the right and in front, (3) back to the right and posterior, and (4) back to the left and posterior. It will be observed that the four positions are arrived at by going round the abdomen of the mother in an anti-clockwise manner, starting from the left anterior position (Figs. 23, 24).

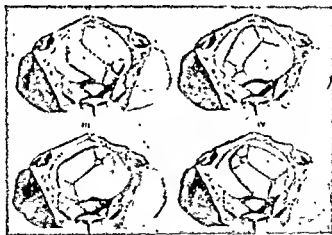


Fig. 24. Four positions of the foetus as felt from below.

In cephalic presentations, there is further subdivision according to the degree of flexion or extension of the head. When the head is fully flexed, the *vertex* presents and the engaging diameter is *sub-occipito bregmatic* extending from the nape of the neck to the middle of the bregma and measuring 9.4 cm. (3 3/4 in.). The

vertex is that part of the foetal skull bounded by the coronal suture in front, the lambdoid suture behind, and the parietal eminence on either side.

With slight deflexion of the head, the engaging diameter is *sub-occipito frontal*, and measures 10 cm. (4 in.), extending from the nape of the neck to the anterior end of the bregma.

With further deflexion, midway between full flexion and full extension, the engaging diameter is *occipito frontal*, extending from occipital protuberance to the root of the nose. It measures 11.3 cm. (4½ in.).

When the head is further extended, the brow presents, and the engaging diameter, the *mento vertical*, extends from the chin to a point one inch in front of the posterior fontanelle. It is the longest diameter and measures 13.8 cm. (5½ in.).

The two diameters engaging in face presentation are: (1) In an incompletely extended face, the engaging diameter is *sub-mento vertical*, extending from a point below the chin to the centre of the sagittal suture, and measuring 11.3 cm. (4½ in.). (2) In a completely extended face, the engaging diameter is *sub-mento bregmatic*, extending from a point below the chin to the centre of the bregma, measuring 9.4 cm. (3 ¾ in.) (Fig. 25).

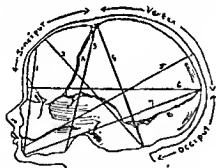


Fig. 25. Side view of foetal skull showing diameters. 1, fronto-mental; 2, sub-occipito frontal; 3, sub-mento bregmatic; 4, sub-occipito bregmatic; 5, mento vertical; 6, occipito frontal; 7, occipito mental.

The two important transverse diameters of the head are: (1) the *bi-parietal*, 9.5 cm. (3 ¾ in.) between the two parietal eminences, (2) *bi-temporal*, 8 cm. (3¼ in.) between the anterior ends of the coronal suture (Fig. 26).

The greatest circumference of the head is the plane of the *occipito-frontal* diameter, measuring about 34.5 cm., while the least

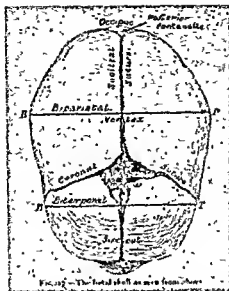


Fig. 26. Foetal skull as seen from above.

circumference is the plane of the suboccipito-bregmatic diameter, 32 cm.

Foetal Skull. The foetal skull consists of two parts, the base and the vault. The bones of the base of the skull are firm and incompressible. The base is formed by the basic sphenoid and the basic occiput.

The vault of the skull is divided into three parts for descriptive purposes: (1) The part from the root of the nose to the middle of the anterior fontanelle is called *sinciput*. (2) The area from the middle of anterior fontanelle to the posterior fontanelle is known as the *vertex*. The part from the posterior fontanelle to just below occipital prominence is called the *occiput* (Fig. 25).

The vault consists of four tabular bones: the frontal, the two parietals and the occipital. These plate-like bones are loosely joined together at their edges by sutures and fontanelles. The vault of the skull is, therefore, plastic and considerable alteration in its shape occurs during labour by the overlapping of the edges at the sutures and the fontanelles. This process is known as 'moulding' of the head.

Fontanelles. Fontanelles are gaps between the angles of the parietal bones and the neighbouring bones of a foetal or infant skull which are closed by membranous structures. The word fontanelle signifies the rhythmic pulsation due to the flow of blood in the vessels of the brain. There are six fontanelles of which

only two are important in obstetrics: the anterior or *bregmatic* situated at the junction of the coronal and sagittal sutures, and the posterior or *lambda* situated at the junction of the sagittal or lambdoid sutures (Fig. 26).

The anterior fontanelle is diamond shaped and is membranous at birth and remains so until about nine months of postnatal life when it is ossified. The posterior fontanelle is, as a rule, ossified at full term and is felt as a triangular bony depression.

The obstetric significance of the two fontanelles lies in their being situated in the midline at either ends of the sagittal sutures. Palpation of these fontanelles during labour offers an important guide to the position and attitude of the foetal head. In anterior positions of the head the occiput is anterior in the midline or slightly oblique and the posterior fontanelle is then situated anteriorly, the anterior fontanelle lying posteriorly is not palpable when the head is fully flexed but only when the head is deflexed.

When the back is lateral, postero lateral or directly posterior, the head is usually in deflexed attitude and the posterior as well as the anterior fontanelles are palpable on opposite sides.

Moulding. The skull is composed of two types of bones: the non-rigid vault and the rigid base. The vault is composed of pliable plate-like bones, the frontal, the parietals and the membranous part of the occipital bone. They are loosely joined by the frontal the sagittal and the lambdoid sutures.

Foetus

The alteration in the shape of the head is brought partly by the bending of the bone and partly by the overlapping of the bones along the sutures. Alteration in the shape of the vault by bending is chiefly due to the bending of the parietals and the frontal. The occipital bone is more rigid and hardly bends. The displacement is mostly of the occipital bone at the lambdoid suture. The plate-like part of the occipital bone has a hinge-like joint between the basal portion which allows forward or backward movement. It will be evident that a decrease in the antero posterior diameter of the vault is brought about by the forward displacement of the occipital bone under the parietals at the lambdoid suture. This occurs during labour in vertex presentations and the after-coming of the breech. Increase in the antero posterior diameter is by backward of the plate of the occipital bone with

widening of the lambdoid suture. In face and brow presentations, there is an increase in the antero-posterior diameter. This process of alterations in shape is known as 'moulding'.

The pliable bones of the vault are reinforced by four sheets of dura mater, the falx cerebri, the two halves of the tentorium cerebelli and the falx cerebelli. These septa have a protective function in labour by preventing excessive alterations in the shape of the cranial vault. The important venous sinuses course along these dural septa. Any movement of the bones of the vault is transmitted to, and is resisted by, the attached septa. These dural septa are not of equal strength and thickness throughout. The particular parts of the septa which are likely to have to bear the greatest strain are strengthened by aggregation of fibrous tissue. On sound principles of mechanics, the dura along the attachment of the falx cerebri to the superior surface of the tentorium cerebelli is considerably reinforced by fibrous tissue. A second point of reinforcement of the dura mater is at the torcular Herophili where the superior longitudinal, the two lateral and the occipital sinuses meet.

During the passage of the head through the birth canal, it is subjected to the action of compressive forces which are the resultant between the force of uterine contractions and the resistance of the maternal passages. The head is therefore in a state of stress during labour. This stress is met by moulding of the head. Moulding, upto a point, is a necessary process even in the easiest labour, without which many a foetus could not be born. Excessive moulding, on the other hand, is dangerous, because the dural septa are overstretched and lacerated with trauma to one or more of the venous vessels coursing along their surface.

CHAPTER 3

FORCES CONCERNED IN LABOUR

The changes which take place in the uterus preparatory to the successful termination of labour are not only amongst the most interesting phenomena of labour but are also of the greatest practical importance. These changes, brought about by uterine contractions and the evolution of uterine contractibility throughout pregnancy and labour, have been studied extensively by Reynolds, by Jeffcoate, and by Caldeyro-Barcia and his associates in recent years. These preparatory changes commence from the thirtieth week of pregnancy and are termed *prelabour* changes. The uterus is, so to say, gradually keyed up prior to labour.

During the last 150 years and more, obstetricians have devoted much thought and energy over this problem. Most of these observations have been upon frozen sections made from the bodies of women dying late in pregnancy, and during the first and second stages of labour. Much controversy has been raised as to the probable origin and extent of these anatomical changes, and conflicting views have been expressed by eminent obstetricians of the time.

The anatomical changes brought about during prelabour and the first and second stages of labour are described first, followed by the physiological basis and functions of these changes.

Cervix in Later Part of Pregnancy. On vaginal examination after the 28th week of pregnancy, the cervix is found to be much softer and somewhat broader than in the non-pregnant condition. In a great majority of cases, the cervical canal during prelabour remains practically unaltered. The cervix appears as a fusiform canal, 3-4 cm. in length, with the internal and the external os at either ends. In most of the cases, the internal os is tightly closed prior to the onset of labour, but, occasionally, the resistance of the internal os has given way so that the upper part of the cervical canal has become continuous with the uterine cavity. The condition of the external os varies in primiparae and multiparae. In primiparae, the external os is tightly closed, while in multiparae it is frequently open so that the index finger can be readily passed through the funnel-shaped cervical canal (Figs. 27, 28). When

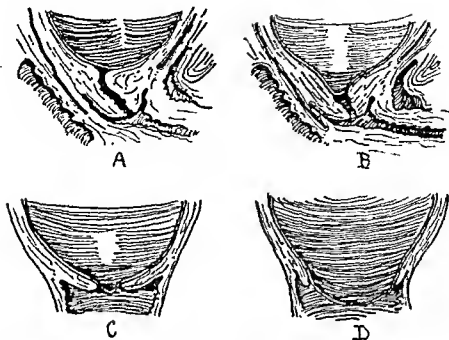


Fig. 27. Mode of dilatation of cervix in primiparae.

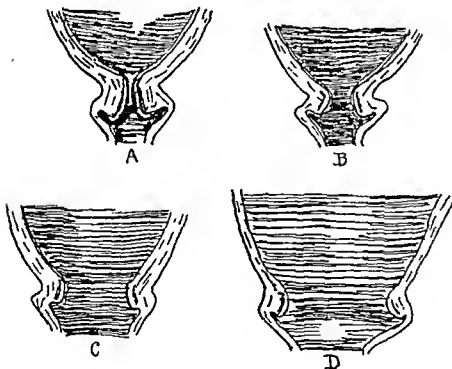


Fig. 28 Mode of dilatation of cervix in multiparae.

the resistance of the internal os has also yielded, the index finger touches the presenting part directly.

Lower Uterine Segment. Immense literature has been published regarding the interior of the uterus. As mentioned before, these changes have been studied in frozen sections of the bodies of women dying during labour and conflicting observations have been reported. Braune, in 1872, put forward the view that the interior of the uterus was divided into two parts by a projecting circular ridge, 10 to 11 cm. above the dilated external os. Braune considered this ridge as the internal os and concluded that the thick-walled portion of the cavity above this ridge was the upper segment of the uterus and the thin-walled portion below the ridge was the lower segment. According to him, the lower segment was formed entirely from the cervical canal. Bandl, a contemporary, disputed this view, and rightly pointed out that it is inconceivable that the closed fusiform cervical canal, measuring 2.5 to 3.5 cm. at the end of pregnancy, could be converted within a few hours into a thin walled distended structure described by Braune.

Since these conflicting observations of Braune and Bandl, two main views have been advanced for the origin and extent of the lower uterine segment. According to one view, the entire lower segment—from the external os to the projecting ridge—is derived entirely from the cervix. According to the other view, it is partly derived from the cervix and partly from the lower portion of the body of the uterus.

Aschoff, in 1908, pointed out that in the non-pregnant uterus a narrow portion, the *isthmus*, separates the uterine cavity from the cervix, and is lined by typical uterine mucosa.

The controversy could have been easily settled by the study of the microscopic structure of the walls at different levels to conclude whether the entire segment is of cervical origin or is partly derived from the lower part of the uterus. Unfortunately, the finer histological details are destroyed in frozen sections. There is, however, a general agreement regarding the second view—that the lower segment is partly derived from the lower part of the uterus and partly from the dilatation of the fusiform cervical canal.

Changes in Uterus During First Stage of Labour. The uterus is differentiated into two parts which are separated from one another by the circular ridge known as the retraction (Bandl's) ring (Fig. 29). As the first stage progresses, this differentiation becomes more and more marked. The part above the retraction ring is the up-

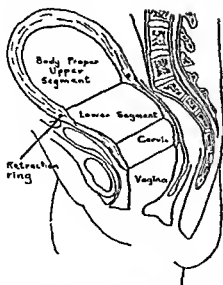


Fig. 29. Diagrammatic illustration of different divisions of parturient canal.

per, thick, actively contractile portion, while the part below, including the cervical canal, is the passive, thin walled lower segment.

With the onset of labour pains, the resistance of the internal os yields and gradually the cervical canal dilates from above downwards. The whole cervical canal distends and merges with the portion of the lower segment derived from the so-called isthmus of the uterus. There is no evidence of the internal os now, and one continuous cylindrical canal is formed which is separated from the vagina by the yet undilated external os. The external os is the last to dilate but, while the cervical canal is being obliterated, it usually thins out.

These changes in the cervical canal result from: (1) retraction of the muscle fibres of the upper segment of the uterus, and (2) the formation of 'bag of waters'.

Retraction of Muscle Fibres of Upper Segment. The phenomenon of retraction is unique and peculiar to the uterine muscle during labour. The difference between contraction and retraction is that, during a contraction, the muscle fibres shorten temporarily and regain their original length during relaxation. In labour, after each contraction, the muscle fibres do not regain their original length during relaxation but a slight permanent shortening occurs. This phenomenon is known as retraction. As a result of retraction, the wall of the upper segment gets gradually thicker and shorter, and the capacity of the cavity of this segment is correspondingly diminished. Retraction exerts a longitudinal traction on the cervix

causing its progressive ripening, effacement and dilatation.

As the capacity of the upper segment gradually diminishes, the foetus is, so to say, progressively squeezed out into the lower segment. The formation of the passive lower segment is therefore purposeful and benevolent to the foetus which otherwise would be subjected to undue pressure from the retracted walls.

As the lower segment is pulled up by the longitudinal retracting muscle fibres of the upper segment, the presenting part progressively descends. The lower segment, in a normal labour, undergoes circumferential dilatation with the consequent thinning during the first stage.

Intra-amniotic Pressure. With the onset of labour, the intra-amniotic pressure rises and, during a contraction, it rises to 50 mm. Hg. The force exerted upon the liquor amnii is transmitted equally in all directions (general intra-uterine pressure). As the lower uterine segment offers the least resistance, the tension and the resistance are the least in the lowermost part. When the internal os opens at the commencement of labour, the lower dependent portion of the bag enters the cervical canal and, acting as a wedge, aids dilatation of the cervix (Fig. 30). After the external os has dilated



Fig. 30. Diagram representing general intrauterine pressure.

to about 5 cm., the presence of the cervical bag of waters protruding through it is not of much assistance in further dilatation. On the contrary, further dilatation is often tardy with an intact bag.

The foetus is protected from prolonged direct pressure of the uterus on it during the dilatation of the cervix, and the conversion of the lower uterine segment into a cylindrical canal continuous with the vagina. During this stage very little descent of the foetus occurs.

The 'bag of waters' ruptures in many cases when the cervix has almost fully dilated but the bag may rupture prematurely early in the first stage or even before the onset of labour. Occasionally, when the membranes are tough, the bag of waters remains intact until the completion of the second stage so that the foetus is born surrounded by the membranes. The portion of membranes covering the head is designated as *caul*.

When the head is engaged, it fits the lower uterine segment and the bag of waters is divided into a small portion below the head, known as 'fore waters' and a large part above the head, known as the 'hind waters'. In such circumstances, when the bag ruptures, only the small quantity of liquor present in the 'fore waters' escapes besides a little from the hind waters. The bulk of the liquor amnii comes out after the foetus is born. When the head is floating, in breech presentation, and in oblique lie of the foetus, this separation into fore and hind waters does not occur and the increased intra-amniotic pressure, during uterine contractions, is equally transmitted to all the portions of the membrane. As a result, premature rupture of the membranes frequently occurs.

After rupture of the membranes, the foetus is subjected to varying degrees of direct pressure from the uterine walls, direct intra-uterine pressure (Fig. 31). The pressure is less when a fair amount of liquor amnii remains in the hind waters. When, however, the amniotic fluid has almost completely drained off, the force exerted by the uterine contractions on the fundus is directly transmitted to the presenting part by way of the vertebral column, known as 'foetal axis' pressure (Fig. 32).

Changes in Uterus and Lower Genital Canal During Second Stage. When the cervix is fully dilated, the cylindrical uterine cavity becomes continuous with the vaginal canal. A pathway for the descent of the foetus is prepared. Descent of the foetus under normal conditions continues slowly until the foetus is delivered (Fig. 29). The upper segment increases greatly in thickness and,



Fig. 31 Diagram representing direct intrauterine pressure.

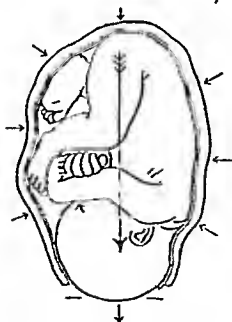


Fig. 22 Foetal axis pressure.

as the stage progresses, covers progressively the decreasing portions of the foetus. When the head is upon the perineum, less than one-half of the foetus is in the upper segment. The lower uterine segment elongates during the second stage. This elongation is proportional to the resistance offered to the foetal descent. The retraction ring, represented on the outer surface of the uterus as an oblique groove, above the symphysis pubis is seldom visible in normal labour because there is very little resistance to the descent of the foetus. In obstructed labour, however, there is a marked elongation of the lower segment; and this is evident by the presence of the retraction ring as an oblique groove in the abdomen. In cases where obstruction is not promptly relieved, the ring continues to rise in the abdomen and may rise as high as the umbilicus. In such circumstances, rupture of the markedly distended lower segment is imminent and will occur if labour is not promptly terminated.

As the head descends through the pelvis, more than half of the entire length of the foetus lies below the retraction ring. As a result, the force of the upper segment, exerted by the uterine contractions, is considerably reduced. To compensate the reduced force, the contractions of the abdominal muscles come into play.

The changes in the vagina and in the pelvic floor during the second stage are entirely due to the pressure exerted by the presenting part. As the head descends, the length of the anterior vaginal wall remains practically unchanged. On the other hand, the posterior vaginal wall is greatly stretched.

The levator ani are stretched and thinned by the progressive descent of the head. The superficial perineal muscles are thin and delicate, and possess no obstetric significance.

The perineum, which is 3 to 5 cm. in thickness, is stretched by the advancing part. The distance between the fourchette and the sphincter ani increases to 10 cm. or more. Such enormous stretching reduces the perineum into an almost thin, transparent, membranous structure, barely 2 to 5 mm. in thickness.

The anus becomes dilated, particularly the anterior half of the anal sphincter, and the mucous membrane of the anterior rectal wall is everted through the gaping anus.

Physiology of Third Stage. Normally, the placenta remains attached to the uterus until the expulsion of the foetus. It would be expected that the reduction in the size of the upper segment, as a result of retraction of the musculature in the latter part of the

first and the second stages, would cause slight separation of the placenta before the expulsion of the foetus; but this is prevented by the foetus firmly pressing the placenta against the uterine wall.

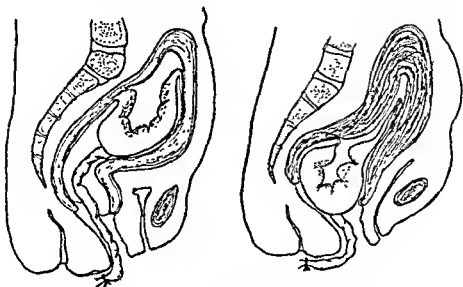
As the child is being born, there is considerable reduction in the size of the uterus. The cavity of the firm upper segment is almost completely obliterated, while that of the soft lower segment is thrown into folds. The walls of the uterus become several centimetres thick and, as the uterus continues to contract and retract, the muscular walls become thicker and thicker, and the area of the placental attachment, consequently, becomes smaller and smaller. The placenta, being inelastic, cannot accommodate the progressively diminishing uterine placental area, and is peeled off from the uterine wall. The separation takes place in the spongy layer of the decidua basalis so that a part of the decidua is cast off with the placenta.

Mode of Separation of Placenta. Two modes are conventionally described and are known as Schultze's and Duncan's methods. The choice of names for these methods is rather an unfortunate one because, almost a hundred years previously, Baudeloque, in 1789, had already described these two modes of separation.

Schultze's Method. Schultze described this mode of separation in 1865. The centre of the placenta is pushed forward by an effusion of blood beneath it. As the effusion of blood increases, more and more of the placenta and, eventually, the entire placenta is separated by the formation of a large retroplacental haematoma. The separated placenta becomes inverted upon itself and presents by its foetal surface. It then passes through the opening in the membranes. As the placenta comes lower and lower, the membranes are separated by traction exerted by the weight of the placenta (Figs. 33, 34).

Separation by Schultze's method is evident when the placenta appears at the vulva with its foetal surface in the shape of a cone. The membranes are separated by the attendant either by twisting them or by to and fro traction. In this mechanism, there is usually no bleeding until the placenta has been delivered when the retroplacental blood, collected in the inverted bag of membranes, escapes.

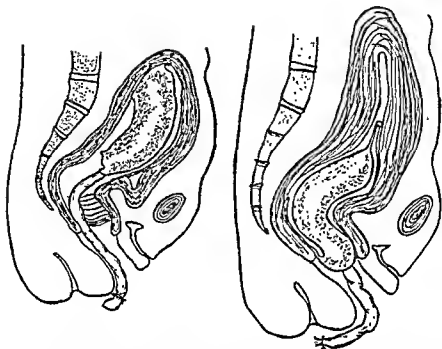
Duncan's Method. According to Duncan, the placenta is separated by inequality in the maternal surface of the placenta and the area of attachment of the placenta to the uterus. The placenta is an inelastic organ and, when the uterine area diminishes after the



Figs. 33, 34. Diagram showing separation of placenta by Schultz method.

delivery of the child, it is peeled off from its attachment. Usually, separation commences at the unsupported lower margin of the placenta. The detached placenta slides down along the wall of the uterus, and the lower margin of the placenta first appears at the vulva. In this mode of separation, there is a slight but continuous bleeding after the birth of the child until the placenta is delivered (Figs. 35, 36).

Personal clinical experience as well as statistics from large institutions reveal that in more than three-fourths of the cases, the placenta separates by the Schultz Method. This mode of separation is favourable in two respects. First, there is hardly any bleeding during the interval between the birth of the child and the separation and the expulsion of the placenta. It will be recalled that in Duncan's method, there is a slow continuous trickle of blood from the birth of the child until the placenta is delivered. Second, the membranes are usually expelled intact in Schultz mode while they are frequently incomplete when the placenta separates by the Duncan mode.



Figs 35, 36. Diagram showing separation of placenta by Duncan method.

CHAPTER 4

PHYSIOLOGY OF UTERINE ACTION

The method of recording uterine contractions, employed by Caldeyro-Barcia and his associates, is given here. The intra-myometrial pressure is recorded simultaneously in three different parts of the uterus by microballoons introduced into the mass of myometrium, each of which is connected by a thin polyethylene catheter to an electromanometer. The intra-amniotic pressure is recorded by introducing a thin polyethylene catheter through the abdominal wall into the amniotic sac. The catheter is connected to an electromanometer (Fig. 37).

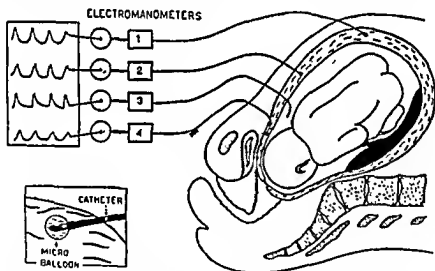
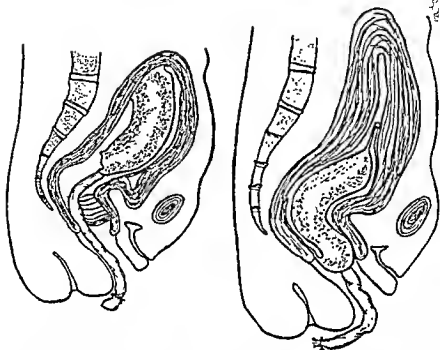


Fig. 37. Method of recording uterine contractility. After Caldeyro-Barcia and Alvarez.

The terms used for recording the results are: The *tonus*, which is the lowest pressure recorded between contractions. The *intensity*, (amplitude) of each contraction is measured by the rise in pressure (mm. Hg) in the amniotic fluid. The *frequency* is expressed as the number of contractions per 10 minutes. The *uterine activity* is defined as the product of the intensity and the frequency of uterine contractions and is expressed in Montevideo Units, that is mm. Hg per 10 minutes.



Figs 35, 36. Diagram showing separation of placenta by Duncan method.

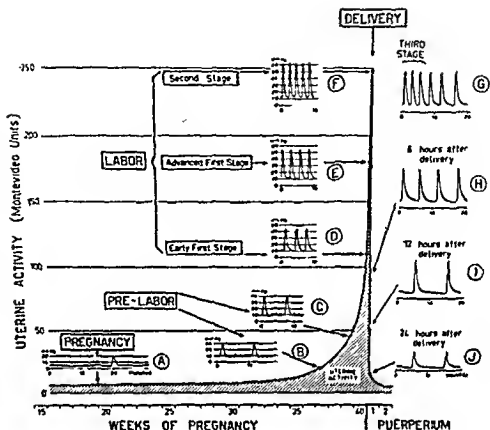
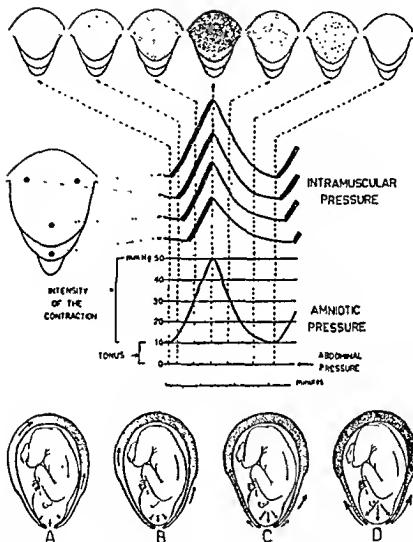


Fig. 33. Schematic illustrations of uterine activity during pregnancy, pre-labour and labour. After Caldeyro-Barcia and Poseiro.

Due to good coordination between the different parts of the uterus, the amniotic pressure assumes a regular form with a single peak. The simultaneous relaxation of all parts allows the amniotic pressure to fall to the normal tonus (10 mm. Hg). Incoordination of the different parts of the uterus is demonstrated in the tracing of the intra-amniotic pressure by irregular form, diminished intensity, greater frequency and increased tonus.

The most significant feature of uterine contractions in a normally progressing labour is that the fundus has a strong sustained contraction; the middle zone contracts simultaneously but the contraction is less intense and is of shorter duration; the lower segment, however, remains inactive. Another feature of uterine action during labour is retraction of the muscle fibres of the upper segment. This is responsible for gradually pulling up and thinning out of the



Figs. 39, 40. Schematic illustrations of spread of contraction wave during labour. After Alvarez and Caldeyro-Barcia.

(Figs. 37 to 40. Courtesy: Modern Trends in Obst. & Gyn., Int. Cong. of Gyn. & Obst., 1938. Librairie Beauchemin Limitée, Tome I)

lower segment. The cervix is also "taken up" by the retracting upper segment so that it becomes part of the lower segment. The external os is fibrous; and its dilatation depends partly on the coordinated uterine action and partly on its own softening and stretching.

Functions of Uterine Contractions. (1) Effects on Lower Parts

of Uterus. During each contraction, the upper segment shortens and exerts a longitudinal traction on the cervix, resulting in its progressive ripening, effacement, and dilatation. After each contraction, the upper segment remains shorter and thicker (retraction of fibres), while the cervix becomes more effaced and dilated.

The downward pressure exerted by the presenting part also contributes to the effects of the contractions on the lower parts of the uterus.

(2) *Descent and Delivery of Foetus.* Because the lower part of the uterus and the cervix is fixed by the utero-sacral ligaments, the shortening of the contracting uterus pushes the foetus downwards.

During the second stage, bearing-down effort produces strong, short-lasting but rapid elevation of intrauterine pressure which adds to the rise of the pressure caused by uterine contractions.

(3) *Effects on Placenta.* During the delivery of the foetus, the upper segment shortens with each contraction so that it is considerably shortened after the delivery of the foetus. This marked shortening of the upper segment diminishes the area of the placental attachment and causes separation of the placenta.

After the delivery of the foetus, the uterine contractions compress the placenta and the vascular pressure within the placenta is raised. If the cord is not clamped until it ceases to pulsate, about 60-80 c.c. of placental blood is transfused into the foetal circulation.

As a rule, two or three contractions suffice to complete the separation of the placenta and to expel it from the upper segment into the birth canal.

(4) *Maternal Circulatory Effects.* The uterine contractions compress the intrauterine vessels of the placenta, and by this mechanism the maternal blood within the uterus is driven towards the vena cava. In this manner, the small and rapid uterine contractions, during pregnancy, prevent stagnation of blood in the myometrium and the intervillous space of the placenta.

During labour, the strong, frequent contractions express as much as 300 c.c. of venous blood from the myometrium. This increased venous return produces an increase in the cardiac output and a rise in the arterial pressure.

When the patient is lying down, the heavy relaxed uterus lies

over the vena cava and diminishes return from the lower limbs and the pelvic structures. During contraction, the uterus rises and reduces the pressure on the vena cava. The blood, which had accumulated in the lower part of the body during uterine relaxation, is propelled into the right side of the heart during contraction. During contraction, therefore, the venous return is considerably increased from the lower parts of the body by release of pressure on the vena cava and by the expression of blood from within the myometrium, and the intervillous space of the placenta.



CHAPTER 5

MECHANISM AND MANAGEMENT OF LABOUR

Normal Labour. Spontaneous delivery of a full term foetus presenting by the vertex without any morbidity to the mother or the new born is termed normal labour.

Onset of Labour

Certain symptoms indicate the impending or established labour. They are 'show', painful uterine contractions, backache and leaking of liquor amnii.

Show. The term "show" is applied to the appearance of small quantities of blood-stained mucus from the vagina. In some, show and true labour pains occur almost simultaneously but, in others, the show precedes the onset of labour by 24 to 48 hours. Show is the extrusion of the mucus plug which occludes the cervical canal during pregnancy. In a number of cases, during the interval between show and the starting of labour pain, effacement or even slight dilatation of the cervix occurs and, when true labour pains set in, these preliminary preparations shorten the duration of the first stage.

Painful Uterine Contractions. In the majority of cases, painful, rhythmic uterine contractions herald the onset of labour. True labour pains have to be distinguished from false labour pains which sometimes occur as early as three to four weeks before the termination of pregnancy. They occur at irregular intervals, are of short duration and do not increase in intensity or duration as is characteristic of true labour pains. The only certain way of distinguishing between false and true labour pains is by the effect they produce on the cervix. True labour pains produce progressive effacement and dilatation of the cervix, while false labour pains do not produce any such effect.

Backache. Backache, without any appreciable abdominal pain, occasionally occurs at the onset of labour. Backache may be continuous or it may be felt by the patient at regular intervals. Although the patient does not feel any abdominal discomfort, uterine contractions can be detected by placing the hand on the abdomen.

Backache without abdominal pain, usually, signifies incoordinate uterine action.

Leaking of Membranes. The leak is usually high above the membranes and only a small quantity of liquor drains away. Labour pains may commence within a few hours but, when the leak is plugged within a short time, labour may not set in for several days. At times, the membranes rupture below the presenting part and then considerable quantity of liquor amnii gushes out and labour commences within a few hours. Rupture of the membranes is particularly likely to occur in cases where the presenting part is not well applied to the pelvic brim. One of the suggested causes of the onset of labour is increased intrauterine tension as term approaches and it is probable that the leak or the rupture may be a manifestation of increased tension.

Causes of Onset of Labour

Many theories have been put forward to explain the onset of labour but none of them is satisfactory. Parturition is a complex process which cannot be explained by assigning any single cause for the initiation of labour. The conditions necessary for the onset of labour develop during the course of weeks preceding full term and should not be regarded as of sudden occurrence. Caldeyro-Barcia and others have shown that uterine activity is heightened during the last trimester of pregnancy in preparation for initiating painful uterine contractions of labour.

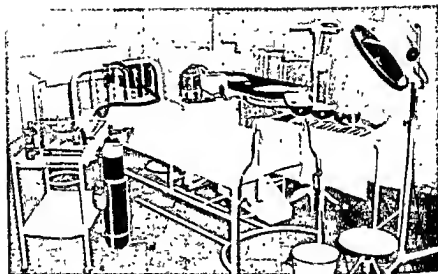
The important factors involved in this complex process are: (1) changes in the hormone balance; (2) tension in the uterine wall; and (3) increasing foetal nutritional demands.

Changes in Hormone Balance. Oestrogen. The role of oestrogen in initiating the onset of labour pains is not clear. Considerable evidence has accumulated to suggest that it does have some determining influence on the uterine muscle. The level of oestrogen in the blood and urine is highest near full term. It is not, however, evident whether the high concentration of oestrogen has a direct action on the myometrium or, more probably, it has the direct effect of stimulating the posterior pituitary to release oxytocin. Reynolds suggested that oestrogen has the property of coordinating uterine contractions.

Progesterone. It was believed for a long time that progesterone acted by relaxing the uterine muscle and lowering its sensi-



Pl-41 Labour ward of Nowrosjee Wadia Maternity Hospital, Bombay.
(p. 135).



Pl-42. Labour room with its equipment. (Courtesy: B. D. Petit Parsee
General Hospital, Bombay) (p. 135).

vity to oxytocin, but recent work has demonstrated that progesterone does not inhibit uterine contractions. At one time, Jeffcoate suggested that a fall in the progesterone level was necessary for promoting uterine contractions by oestrogen.

Recent work suggests that it is not the opposing action of oestrogen and progesterone that promotes uterine activity, but rather a synergistic action on the human uterus throughout pregnancy, first in sustaining pregnancy until term and later in initiating labour pains.

It has been suggested that adrenaline and nor-adrenaline of maternal origin have a stimulating action on the human uterus, but the evidence is conflicting and no conclusions can be drawn from it.

Tension in Uterine Wall. As a result of the mechanical effect of the enlargement of the uterus, there is stretching of the uterine muscle and increased tension. Unless the distension of the uterus is great, this increased tension stimulates muscular activity. A clinical evidence in favour of uterine contractions being stimulated by increased tension is the frequent premature onset of labour in multiple pregnancy and in cases of hydramnios.

Foetal Pressure on Uterine Wall. During the last few weeks of pregnancy, the proportion of liquor amnii to the size of the foetus is reduced and the foetus comes in contact with the uterus. The mechanism by which direct pressure of the foetus on the uterine wall stimulates labour pains is not known but it is suggested that pressure on the lower segment and the paracervical nerve ganglia may be the stimulating factor.

Increasing Foetal Nutritional Demands. As the foetus grows, its nutritional demands increase but, as a result of the aging of the placenta and degenerative changes in it, these demands are difficult to meet and, hence, labour begins. It is suggested that, as a result of placental degeneration, the oxytocic principle is liberated which then activates uterine activity.

It may, therefore, be concluded that our present knowledge regarding the onset of labour is grossly deficient, mainly due to the fact that the onset of labour is the result of many diverse coordinating factors and, though there is evidence for each individual factor, the mechanism of coordination of these factors is not known. Reynold's remarks summarise the present state of our knowledge: "parturition begins as a result of the gradual accelerating convergence of a number of factors—structural, hormonal, nervous, nutri-

tional and circulatory—which, at a time, characteristic for each species and adapted to the morphologic condition present in each, are so associated that they lead to evacuation of the uterus of its contents”.

Movements of Foetus During Its Passage Through Birth Canal

Flexion. With the onset of labour, the intrauterine pressure rises, and the attitude of flexion adopted by the foetus during pregnancy is increased. The pressure exerted by uterine contractions is transmitted to the head along the vertebral column. The occipito-atlantoid joint acts as a fulcrum, the shorter arm of the lever being the distance between the occiput and the foramen magnum and the longer one being that between the foramen magnum and the sinciput (Fig. 41).

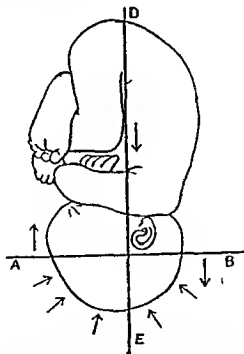


Fig. 41. Diagram showing how flexion is produced.

The plane of the pelvis at which the movement of flexion occurs varies. As the head passes easily through the upper part of the pelvic cavity, full flexion occurs when the occiput meets the resistance of the pelvic floor.

It is evident that the force exerted on the head through the vertebral column is proportional to the intensity of uterine contractions. Flexion is encouraged by strong uterine contractions, while in hypotonic uterine action, deficient flexion is common.

The main advantage of full flexion of the head is that the engaging diameter is the smallest, suboccipito-bregmatic, 9.4 cm.; with deficient flexion, the engaging diameter is occipito-frontal, 11.3 cm.

Internal Rotation. In 60-70 per cent of cases, the head enters the pelvic brim in the transverse or the oblique diameter of the brim and descends in that position until it reaches the pelvic floor. For a spontaneous vaginal delivery, the head must rotate so as to bring its long diameter into the antero-posterior diameter of the outlet. When internal rotation does not occur, the head is arrested and needs to be manually rotated into the antero-posterior diameter of the outlet.

When the head engages in the oblique diameter with the occiput anterior, internal rotation through 45 degrees brings the occiput under the pubic arch. When the head descends in the transverse diameter of the brim, anterior rotation through 90 degrees brings the occiput under the pubic arch; but, in some, it may rotate posteriorly through 90 degrees to bring the occiput into the hollow of the sacrum. When the occiput is situated posteriorly, pointing towards the sacro-iliae joint, in many cases a long anterior rotation through 135 degrees occurs so that the occiput comes to lie under the pubic arch; but, in some cases, short posterior rotation through 45 degrees, into the hollow of the sacrum occurs, (Fig. 42).

Various theories have been advanced from time to time, in an attempt to explain the manner in which internal rotation is brought about, but none of them satisfactorily explains the forward or backward rotation in all the cases. From the beginning of the present century, the explanation put forward by Sellheim has received popular consideration. He maintained that the entire mechanism of labour, including internal rotation, is the inevitable consequence of definite physical laws of inequalities in the flexibility of the different parts of the foetus. He experimentally demonstrated that whenever a cylindrical body of suitable size, which can be bent to a different extent in several localities, is passed through a curved flexible rubber cylinder, it necessarily rotates until the portion

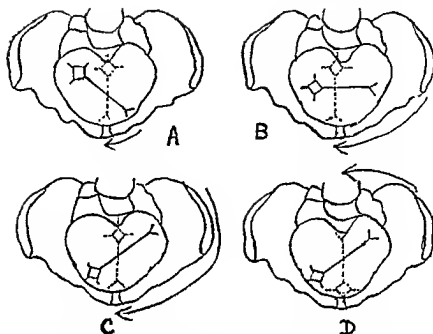


Fig. 42. Diagram showing anterior rotation of the head. A, through 45° anteriorly; B, through 90° anteriorly; C, through 135° anteriorly; D, through 45° posteriorly.

which is most readily bent adapts itself to the curvature of the canal.

In the ultimate analysis of the causes influencing internal rotation, it appears that the shape of the bony pelvis, the position in which the occiput engages, and the nature of the uterine action determine the manner of internal rotation of the head. The available room in the anterior and posterior segments of the pelvic cavity determine the forward or backward rotation. That the nature of uterine action by itself is an important factor is evident from the clinical observations that, even when the occiput is situated posteriorly, long forward rotation of the occiput frequently occurs when uterine contractions are strong and that, under similar conditions with weak uterine contractions, the occiput fails to rotate.

Extension. When the forward rotated flexed head reaches the pelvic floor, it must extend to be born from the vulval outlet. Extension is brought about by the resultant of the two forces, one acting downwards as a result of uterine contractions and the other upwards by the resistant pelvic floor.

Extension occurs only after the sub-occipital region has come under the inferior margin of the symphysis pubis. Now the sub-occipito bregmatic diameter distends the vulva with 'crowning' of the head (Fig. 43). From now on the occiput acts as a

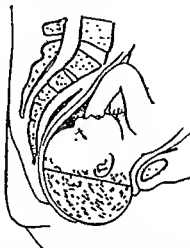


Fig. 43. Partial extension with crowning of the head.

fulcrum and the head extends so that successively the vertex, the forehead, the face and, finally, the chin emerge from the anterior margin of the perineum (Fig. 44).

When the occiput rotates into the sacral hollow, spontaneous delivery sometimes occurs in what is known as 'face-to-pubis position'. The forehead or the root of the nose comes under the symphysis pubis. The occipito frontal diameter distends the vulva. The vertex and the occipital region are born by partial flexion and, finally, the face is born by a movement of extension (Fig. 45).

Restitution. During internal rotation of the head, some degree of torsion of the neck is inevitable. When the head is born, this torsion is released and the occiput turns slightly to the mother's left or right according to the position of the back. This untwisting of the neck is called restitution (Fig. 46).

External Rotation. As the shoulders reach the pelvic floor, they rotate into the antero-posterior diameter of the outlet and this is evident externally by the lateral rotation of the occiput to the left or the right. The occiput now points towards the tuber ischii. The external rotation of the head is the result of passive transmission of the movement of internal rotation of the shoulders to the head (Fig. 47).

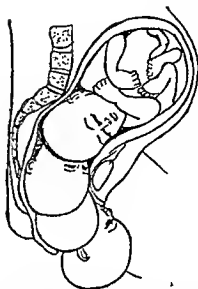
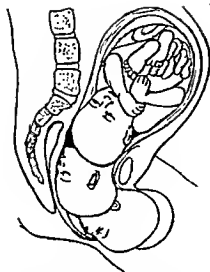


Fig. 44. Stages of rotation and delivery when occiput is anterior. Fig. 45. Stages of rotation and delivery when occiput is posterior.



Fig. 46. Showing the head when restitution has occurred. Fig. 47. Showing the head when external rotation has occurred.

Delivery of the Trunk. The anterior shoulder now engages under the lower margin of the symphysis pubis and the posterior shoulder appears at the anterior margin of the perineum, and is born followed by the birth of the anterior shoulder. The rest of the body emerges from the birth canal.

Management of Labour

That the management of labour is the most important part of obstetric practice needs no comment. Most labours, about 90 per cent, are normal and terminate in a natural way with safety to the

mother and the child, but it should be stressed that an apparently normal physiological process can, for want of proper management, become abnormal endangering the life of the mother or the foetus or both. The great difference between hospital and private practices is that in a well equipped hospital trained medical and nursing personnel, proper surgical asepsis and necessary equipment are available and every labour is conducted with the same care as a surgical operation. In the large cities and towns of India, most of the deliveries take place in obstetric institutions, but in rural areas obstetric practice is yet far from satisfactory, and maternal mortality and foetal mortality are still very high.

The first and foremost consideration in the management of labour is suitable accommodation and equipment of the labour room. The facilities available in a well equipped hospital are described first, followed by requirements when labour is to be conducted in the patient's home.

Labour Room Unit of Hospital. The size of a labour ward will naturally depend on the demands of the particular institution (Plate 41). In the N.W.M. Hospital, on an average 30 confinements occur during 24 hours and the number, at times, reaches 45 or even more. Therefore, a large common labour room, having accommodation for conducting normal labour cases, has been provided. Each bed is screened off by curtains. The screens are put on only during the actual conduct of labour or during vaginal examination so that the sister-in-charge, sitting at her table at the extreme end of her room, can supervise the work of the staff nurses, student nurses and under-graduates working under her. It is for this reason that permanent cubicles isolating the patient have not been provided. In maternity section of a general hospital, where on an average only one or two deliveries occur during 24 hours, the labour room is like a small surgical theatre (Plate 42).

Labour Bed. A labour bed is made of steel and is 180 cm. (72 in.) long, 82 cm. (33 in.) broad and 75 cm. (30 in.) high. The bed is covered by a metal sheet over which there is a stiff surgical rubber mattress. The bearing down efforts of the patient are much better obtained on a hard bed and a hard bed is also more convenient for the obstetrician. Some institutions prefer a bed made in two parts; the upper part is about 4 feet long while the foot end which is detachable is about 2 feet long. During conduction of a breech delivery and while suturing the perineum, the patient has ordinarily to be brought down to the

end of the bed. This is not necessary in a bed made in two separate parts, as the required position can be obtained by detaching the smaller foot end of the bed. Arrangement for putting the patient in the lithotomy position is made in both types of beds. There are also mechanical arrangements for raising the foot end of the bed to put the patient in the Trendelenberg position.

Sterilized Linen. In conducting a normal labour, a pair of leggings and at least four, or preferably six, sterilized drawsheets, 36 inches long and 24 inches wide, should be provided. Throughout the first stage, a sterile vulval diaper is kept in place and changed as frequently as required. While conducting the second stage of labour, one drawsheet is spread on the bed and one over the abdomen for the obstetrician to palpate the uterus with his gloved hands. After the expulsion of the placenta, the vulva is cleaned and fresh drawsheets are put on the bed and over the abdomen before suturing the perineal wound.

Instruments. A tray, containing 6 to 8 artery forceps (2 for clamping the umbilical cord and the rest for catching bleeding points in the episiotomy wound), 3 pairs of scissors (1 for making an episiotomy, 1 for cutting the umbilical cord and 1 for use during suturing the perineum), 2 sponge holding forceps, No. 0 and No. 1 chromic catgut tubes, 1 needle holder, and some cutting and round bodied needles of varying sizes and curves, is provided for each labour bed. An emergency tray for immediate use in case of post-partum haemorrhage is kept ready. The instruments provided are: A broad Sim's speculum with long blades for visualising the upper parts of the vagina and the cervix for tears, 6 sponge holding forceps for holding the cervix at different points along its circumference, a uterine plugging forceps and 3-4 rolls of sterile gauze, 15 cm. wide and 150 cm. long, are also kept ready at hand.

Syringes and Injections. One 2 c.c. syringe is kept for injecting ergometrine or pitocin. A 20 c.c. syringe is kept ready filled with 1 per cent local anaesthetic solution for infiltrating the perineum. Ampoules of ergometrine, pitocin or syntocinon, and pethidine are kept at hand.

Lighting. Labour should always be conducted in good light and a shadowless 'spot' light is of great help.

Sterilizing Unit. In a well equipped institution, a sterilization unit consists of a good sized autoclave, an instrument sterilizer, 24" long, 12" broad and 12" deep, a bowl sterilizer of adequate size, and a hot and cold water sterilizer. The number of drums required

for sterilizing gowns, masks and other linen will necessarily vary for different institutions.

Equipment for Domiciliary Practice. In domiciliary practice, the perfect conditions available in a hospital cannot always be reached, but it should be the constant endeavour of the accoucheur attending the case to aim at this ideal as far as circumstances permit. Sepsis and haemorrhage are the two grave complications of childbirth, and the dangers are obviously greater in domiciliary practice than in hospital practice. Even if a labour is simple and straightforward, it should always be considered as a surgical operation. If an operative delivery becomes necessary, it is advisable to remove such cases to a hospital where, apart from sepsis, facilities for treating obstetric emergencies are ready at hand.

The room in which labour is to be conducted should be cleared of all the easily removable furniture a few days prior to the date of delivery. The room should be fumigated and should not be used for any other purpose. The bed should preferably be of steel but in most homes the labour has to be conducted on a wooden bed. The modern low bed is not convenient for conducting labour and should be raised up, on wooden blocks, to the required height. The bed should be placed in the centre of the room. A lamp on a stand is the best but, if that is not possible, a hand lamp with a long wire must be kept ready. At least two tables should be available for placing linen, instruments and lotion bowls.

The above conditions are usually available in middle class homes but in the working class population of this country very scant facilities are available and it is therefore advisable to provide small maternity homes in the rural areas and to discourage home deliveries. It is possible that after some years when the living and educational standards improve, domiciliary midwifery may again find a place in the obstetric practice of this country. In the homes of the working class, labour has to be frequently conducted on the floor and, in spite of all efforts, sepsis cannot be adequately maintained.

The accoucheur should take with him linen and instruments sterilized at his place. For this purpose, a small autoclave is very convenient. In one drum, he should pack drawsheets, gowns, masks and rubber gloves. In another drum, the necessary instruments are sterilized. In the third drum, bowls of different sizes and a set for giving intravenous infusions should be sterilized. Injections and bottles of antiseptics are carried in a small box. He

should also take with him bottles of 5 per cent glucose solution and, if possible, plasma or plasma substitute should be carried, especially when called upon to deal with an emergency obstetric case.

Preliminary Examination and Toilet. In a hospital, the patient is first taken to, what is called, the "receiving room". Here the nurse on duty registers her name, address, etc. The nurse inquires for the symptoms of the onset of labour, the presence of "show" and painful intermittent contractions to ascertain that the patient is in labour.

The vulva is then shaved and an enema is given. Enema serves the double purpose of evacuating the lower bowel and stimulating labour pains. 'False' pains cease after the enema. A bath is given, either a conventional ablution by pouring water over the body or a shower bath, and the patient is then made to wear clean hospital clothes.

If the patient on admission is so advanced in labour as to deliver immediately, her toilet will have to be limited to only a quick shaving of the vulva.

If there is a history of antepartum haemorrhage or any other grave condition, she is transferred immediately to the labour ward.

Examination in Labour Ward. Registered cases will have an antenatal record of the past general and obstetric history and the history of the present pregnancy, but in unregistered and emergency cases the history has to be recorded now.

Diseases of the mother, like tuberculosis, heart disease, diabetes, anaemia and toxæmias of pregnancy, have an important bearing on the management of labour.

Past obstetric history is equally important. A previous good obstetric history is reassuring while a previous bad history alerts the accoucheur regarding the probable outcome of the present one.

General Examination. The pulse, respirations, temperature and blood pressure must be recorded and a sample of urine should be tested for albumen in every case. Anaemia is so common in the lower income group that it should always be looked for. Oedema of the lower limbs, the vulva, the face and the other sites should be looked for. A thorough examination of the heart and lungs be made. A general examination must precede palpation of the abdomen because it is likely to be neglected if attention is focused from the start on abdominal and vaginal examinations. This

neglect may prove serious in those suffering from cardiac or pulmonary disease or from pre-eclamptic toxæmia.

Abdominal Examination. An abdominal examination is made to note the nature of labour pains, their frequency and intensity. The consistency of the uterus is observed so as to differentiate between: (a) normally contracting and relaxing uterus, (b) an 'irritable' uterus which is tense all the time with marked tenderness over the lower segment and constant backache, and (c) a hard, tender, tonically contracted uterus. If there is overdistention of the abdomen, it is likely to be due to hydramnios, multiple pregnancy, concealed accidental hæmorrhage, associated abdominal tumour or ascites.

The presentation and position of the foetus is palpated in between the contractions and the relation of the presenting part to the pelvis is ascertained. A deeply engaged head at once excludes cephalopelvic disproportion at the brim. A presenting part, which remains at or above the brim after labour has been well established, causes concern and needs constant observation. The anterior shoulder is carefully palpated to ascertain the anterior or posterior position of the head, as occipito posterior position is often associated with non-engagement of the head during labour. An attempt to push the head into the pelvic cavity by Purandare's method must be made as a marked overlapping of the head over the symphysis pubis indicates gross cephalopelvic disproportion.

The foetal heart sounds are heard and their rate and regularity are recorded. The site of the heart sounds is marked by a circle for the guidance of the attendant. Undue reliance should not be placed on diagnosing the position from the site where foetal heart sounds are heard unless the position of the heart sounds is close to the position of the anterior shoulder.

External Pelvimetry. Though external pelvic measurements at the brim are not of much clinical importance, time permitting, they should be taken. In some cases, these measurements indicate the presence of a rachitic flat pelvis or a generally contracted pelvis.

The bony measurements at the pelvic outlet, the transverse and the antero-posterior, should never be neglected, particularly in primigravidae and in those who had a previous difficult forceps delivery. These can be measured accurately by the callipers. The transverse diameter measures between 9 and 10 cm. in average built Indian women and the antero-posterior 11 cm. The character of the pubic arch is important and should be noted carefully.

X-Ray Examination. It is at times necessary to take an X-ray of the abdomen during labour to confirm a suspected malpresentation. Also in cases of cephalopelvic disproportion in primigravidae or in those having a previous bad obstetric history, an X-ray pelvimetry is done during labour and it gives valuable information.

Conduct of Labour

Aseptic Precautions. Vaginal examination during labour must be done with strict aseptic precautions so that organisms from an outside source are not introduced into the genital canal. Freshly boiled or dry sterilized gloves should be put on. The labia are opened wide by the thumb and the index finger of the left hand and the introitus is cleaned, from before backwards, by cotton swabs dipped in warm dettol solution. Three or more swabs are usually required for satisfactory swabbing of the vulva. Pure dettol is taken on the index and the middle fingers of the right hand which are introduced into the vagina without touching the labia. The number of vaginal examinations should be as few as is consistent for observing the progress of labour. For fear of introducing infection, rectal examination is advised by some but a vaginal examination gives more accurate information than a rectal examination. Provided proper aseptic precautions are taken, even repeated vaginal examinations do not carry appreciable risk of infection. It should be remembered that during a rectal examination the finger in the rectum pushes the anterior rectal wall towards the cervix with the intervening posterior vaginal wall, and there is a possible risk of direct contamination of the cervical canal from the organism in the upper part of the vagina. Besides, it requires considerable experience to get proper data by rectal examination.

Management of First Stage of Labour. It is the stage of dilatation of the cervix. It commences from the onset of painful uterine contractions until full dilatation of the cervix. The first stage, on an average, lasts for 12-16 hours in primiparae and 6-8 hours in multiparae. The duration varies considerably depending on the character of uterine contractions, the age of the patient, and the application of the cervix to the presenting part. In cephalopelvic disproportion, malpositions, malpresentations and other causes of obstructed labour, dilatation is tardy because the presenting part, being either unengaged or irregular, does not press on

the cervix uniformly and firmly. In some cases, the cervix may be hanging loose below the presenting part.

After shaving the vulva, the anus and the adjoining area of the skin are properly cleaned by soap and water and a sterile vulval pad is applied. The pad should be frequently changed.

The abdomen is palpated by the accoucheur for noting the presentation and the position of the foetus and whether the presenting part is floating, engaging or deeply engaged. The position of the anterior shoulder is then marked. The foetal heart rate is counted and its location is marked by a circle. The nurse is asked to keep a record of the foetal heart rate. In a normal case, the foetal heart sounds are recorded every hour in the early part of the first stage and every half hour in the latter part of the first stage.

When the patient is admitted after rupture of the membranes or there is leaking of liquor amni from high rupture of the membrane, it is necessary to keep the patient in a lying-down position, but in other cases the patient should be encouraged to sit up and move about.

In a normal case, the patient is encouraged to take light diet and is advised to take good quantity of fluids and fruit juices to prevent dehydration at a later stage.

A confident patient does not demand analgesia until the first stage is well advanced, but an apprehensive patient needs to be sedated earlier by chlorpromazine or allied drugs or by pethidine tablets or injections. At night, some hypnotic drug must be given to every case because a refreshed patient goes through labour the following day more confidently than a tired one.

As the first stage advances, all patients should be given, and in practice all patients demand, analgesia. Pethidine is the drug of choice. At this stage, when contractions occur at frequent intervals, pethidine tablets are not effective and the patient is best sedated by giving 100 mg. of pethidine intramuscularly. Pethidine can be repeated every 4-6 hours, and a total of 400 mg. can be given during 24 hours with perfect safety to the mother and the foetus. Besides the sedative effects of pethidine, it frequently helps dilatation of the cervix. Prior to the introduction of pethidine, morphia, $\frac{1}{4}$ gr., was widely used for analgesia during labour.

When the dilatation of the cervix is tardy, as is often the case in hypotonic uterine inertia or incoordinate uterine action, it is advisable to give intravenously, 200 c.c. of 25% glucose with 10 c.c. of 10% calcium gluconate, 500 mg. of vitamin C and 1 c.c. of vita-

min B complex, and to repeat the injection of 200 c.c. of 25% glucose every 6-8 hours. This precaution prevents dehydration and sustains the patient undergoing a prolonged first stage.

When these precautions are taken, the patient does not get exhausted. The so called "maternal distress", in most of the cases, is due to the neglect of these precautions. With these precautions, the general condition of the patient, even when the first stage is prolonged to 24-48 hours, remains the same as at the commencement of labour.

Foetal distress seldom occurs during the first stage. It usually occurs when one or more loops of the umbilical cord are round the neck, or when the cord is presenting or is lying by the side of the head. The signs of foetal distress are: wide fluctuations in the foetal heart rate which also becomes irregular, passing of meconium, and tumultuous movements of the foetus. When the foetal heart rate persistently remains over 160 per minute or slows down to 100 per minute, the accoucheur must be on the alert. When premature rupture of the membranes has occurred, the presence of meconium in the liquor leaves little doubt that foetal distress is either impending or has set in. It should be noted that meconium stained liquor by itself is not of much significance but, when the foetal heart sounds are also unduly rapid or have become irregular, there is no doubt about foetal distress.

It is not always necessary to do a vaginal examination to find out whether the cervix has fully dilated. The patient begins to have an urge to 'bear down' during contractions and the attendant will observe slight gaping of the anus during these bearing down efforts, indicating full or almost full dilatation of the cervix. It should be remembered that in hypertonic incoordinate uterine action, the patient has urge to bear down long before full dilatation of the cervix. A fully dilated cervix does not at once slip over the head from all sides. Usually, the posterior half slips over the face first and later the anterior half slips over the occipital region. The initial gaping of the anus is from the pressure of the face on the lower part of the anterior wall of the rectum. The head cannot descend further along the vagina until the anterior half of the cervix slips over. The dilatation of the anterior half may occur within few minutes or it may take considerable time to slip over the occipital region. The bearing down efforts of the patient at this stage are fruitless and she is likely to get exhausted. She should, therefore, be discouraged to bear down at this stage. When the anterior

lip does not slip over the head for a considerable time, an attempt to push it above the occiput should be made by applying the tips of the index and the middle fingers against the rim of the cervix and exerting upward pressure during contractions.

Management of Second Stage of Labour. The second stage commences from full dilatation of the cervix and ends with the birth of the child. The duration of the second stage is usually 1-2 hours in primigravidae and 10 minutes to 1 hour in multigravidae. The duration of the second stage is judged more by the progressive advance of the presenting part rather than by the limits in the time stated above. The progress may be slow, but, as long as there is advance of the head, the second stage is allowed to extend to as much as 3-4 hours in primigravidae and for more than one hour in multigravidae. In practice, it is a common mistake to consider the beginning of the second stage from the time of the slight gaping of the anus. At this stage, as stated above, the anterior part of the rim of the cervix may still be gripping the head and it is not until the anterior rim has disappeared over the head that the real clinical second stage is said to have begun.

The advance of the presenting part along the vaginal canal is externally apparent by more and more eversion of the anterior half of the anal canal (Plates 43, 44). The attendant should not be deceived by what appears to be the advancing head which, in cases of arrest of the head at the midcavity, is a large, elongated caput succedaneum.

During the entire second stage, foetal heart sounds must be heard at five minutes' intervals. The foetal heart rate slows down and is, at times, irregular during a contraction and for a few seconds after the contraction. Therefore, the foetal heart should be auscultated in between the contractions. Persistent foetal heart rate of 160 per minute or more, or irregularity of heart sounds indicates foetal distress. Steps should be taken to deliver the patient soon, as after a while the foetal heart slows down to 100 or less per minute—a sign of severe foetal asphyxia and impending foetal death.

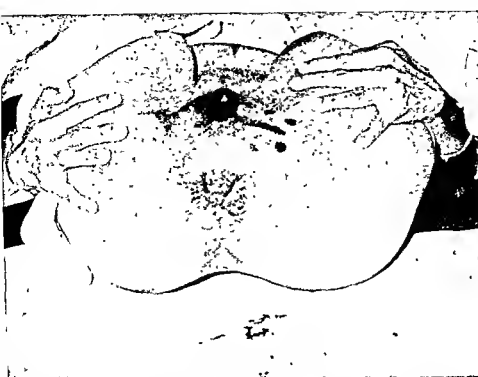
Analgesia during the second stage has been the subject of much discussion and controversy in European countries, particularly in America, where, until recently, patients were kept under deep analgesia throughout the second stage. Recently, the pendulum has swung in the opposite direction and, nowadays, childbirth without fear is becoming more and more established. This change

is largely due to the necessity of forceps delivery in many of the cases kept under complete analgesia, and the higher incidence of post partum bleeding. However, in India, analgesia during the second stage has never been a great problem in the vast majority of cases. Only a few upper class of patients demand complete relief from pain like their sisters abroad. Development of a proper mental attitude towards childbirth is important. The women of the lower income group in India are happy to conceive and to become mothers and are not apprehensive of the pains of childbirth.

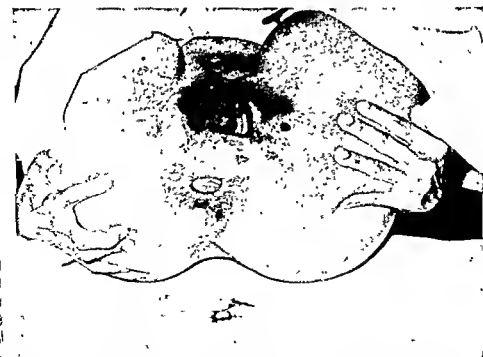
When pethidine has been given during the later part of the first stage, the patients are usually tolerant to the pains of the second stage and this forms the main basis of analgesis, even among the women of the upper class.

Episiotomy. In almost all primigravidae, an episiotomy is necessary to prevent bad perineal laceration and also to avoid prolonged stretching of the perineal tissues. As the head distends the perineum, the distance between the fourchette and the anterior part of the anus increases and may even widen to 4 inches. Such excessive stretching thins out the perineum to almost papery thickness and, unless a timely episiotomy is performed to prevent further stretching, a bad perineal laceration is inevitable. In multigravidae, an episiotomy may be required if there is scarring of the perineum as a result of previous laceration or episiotomy. Local infiltration of the medio-lateral part of the perineum on one side by 1% solution of a local anaesthetic drug should be done when the head appears at the perineum. Episiotomy should not be done until the head has commenced to stretch the perineum as otherwise there is considerable oozing of blood before the head is delivered (Plates 45, 46). The technique of suturing is described in a later section.

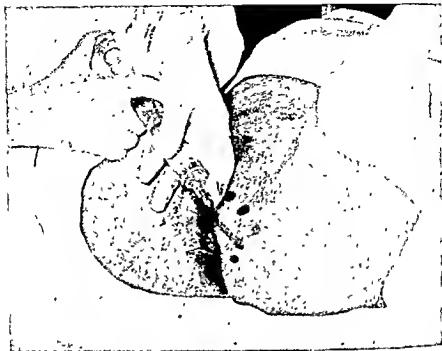
When the head begins to stretch the perineum, it is kept in flexion during each contraction so that the occipital region advances under the symphysis pubis. It is kept flexed until the occiput has emerged well below the symphysis pubis and the nape of the neck is under the symphysis pubis (Plate 47). The object of keeping the head flexed is to allow the smallest diameters to stretch the vulva during extension of the head. The head is allowed to extend very gradually by keeping firm pressure over the vault. When the biparietal diameter stretches the vulva, the head is said to be "crowned". It is now ready to be born but, as far as possible, it should not be allowed to be born during a contraction. When the



Pl-43. Beginning of bulging of the perineum. A small part of the head is seen at the vulva. The markings indicate the site of infiltration of perineum. Note bulging of the anterior part of the anal canal. (p. 143)



Pl-44. A good part of the head is seen distending the vulva. Note the greater eversion of the anterior part of the anal canal. (p. 143).



PI-45 Infiltration of the perineum prior to episiotomy (p 144)



PI-46. Episiotomy being performed. (p. 144).



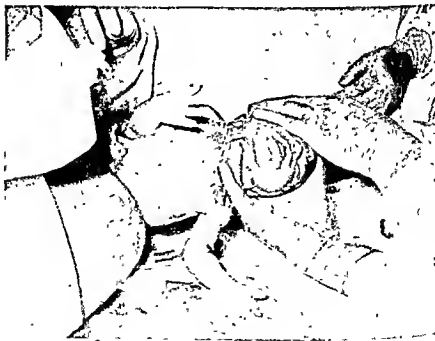
Pl-47. Method of keeping the head flexed until the head is crowned.
(p. 141)



Pl-48. Head is just born. (p. 145).



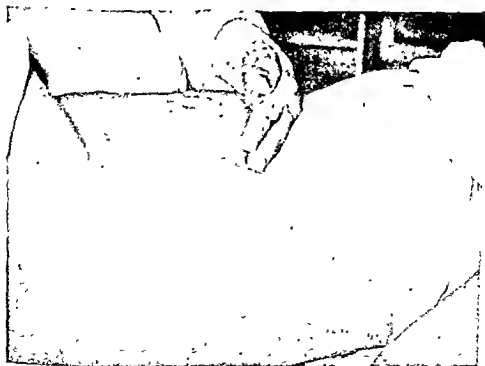
PI-49 Loop of cord being slipped over the shoulders. (p. 145).



PI-50. Trunk being born (p. 146).



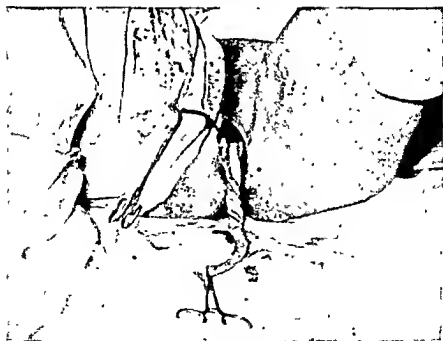
Pl-51. Cutting the umbilical cord between two clamps (p 146)



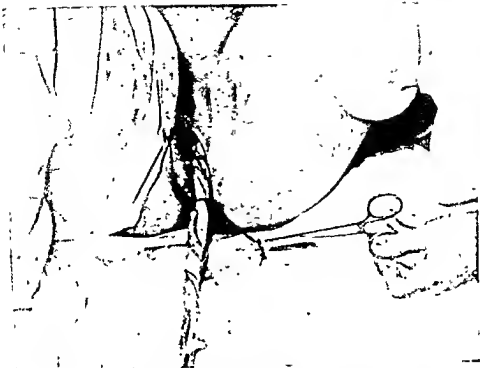
Pl-52 Hand on the abdomen controlling the fundus. (p. 146).



Pl-53 Sandbag on the abdomen controlling the funulus (p 146)



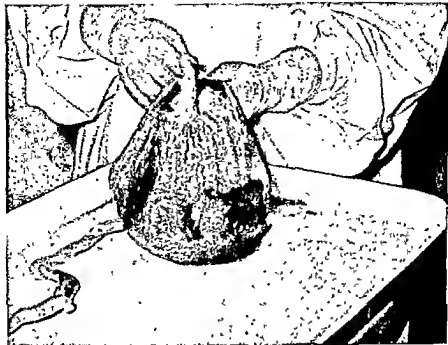
Pl-54 Umbilical cord tied at the vulva. (p 147)



Pl-55. The ligature on cord has slipped down indicating apparent lengthening of the cord and separation of the placenta (p 147)



Pl-56. Placenta delivered. Membranes being delivered by twisting of the placenta. (p 149)



Pl-57. Placenta with intact membranes (p. 149)



Pl-58 Maternal surface of the placenta (p. 149).

contraction has passed off, the pressure of the left hand over the head is released. By pressure on the perineum by the outstretched thumb and the fingers, the head is gently extended until successively the forehead and the face are born (Plate 48). Thus, the smallest diameters, the suboccipito-bregmatic or suboccipito-frontal in vertex presentations and submento-bregmatic in face presentations, all measuring $3\frac{3}{4}$ inches, distend the vulva.

No sooner the head is born, the attendant should feel for loops of umbilical cord round the neck (Plate 49). A single loop, loosely encircling the neck, can usually be unwound by slipping it over the head or over the shoulders but, when there are two or more loops, the cord has to be clamped at two places and cut in between before they can be unwound. At times, a single loop is so tight that it is not possible to slip it over the head or the shoulders and it is necessary to clamp and cut the cord before delivering the head.

It is preferable to wait for the next contraction for delivery of the shoulders and the rest of the body, and, in the meantime, the closed eyelids are swabbed and the mucus at the nostrils is cleaned. When, however, the loops of cord round the neck necessitate cutting the cord or, when before the next contraction the child becomes cyanosed, the delivery of the shoulders is effected by external rotation of the head towards the side of the back. By gentle backward traction on the neck, the anterior shoulder is dislodged from under the symphysis pubis followed by delivery of the posterior shoulder by forward traction on the neck (Figs 48, 49). Forceful traction is likely to stretch the foetal cervical

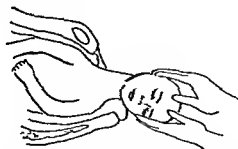


Fig. 48. Depressing the head for delivery of anterior shoulder.

nerve roots and cause Erb's palsy. Therefore, when gentle traction fails, the attendant should hook his fingers under the armpit and by traction on the armpit deliver the shoulders. If enough room for hooking his fingers into the armpit is not available, an



Fig. 49. Lifting the head for delivery of posterior shoulder.

episiotomy or extension of one already performed should be carried out. The rest of the body is delivered by gentle traction without difficulty (Plate 50).

Management of Third Stage of Labour. With the birth of the child the third stage begins. It ends with the expulsion of the placenta and the membranes. Postpartum haemorrhage is the gravest complication of this stage and, since the occurrence of postpartum haemorrhage is in many cases due to mismanagement of the third stage, the importance of proper management of this stage at once becomes self evident.

The first thing to do is to separate the child from the mother by cutting the cord (Plate 51). It is advisable to wait until the pulsations in the umbilical cord cease before clamping the cord.

Immediately after the expulsion of the foetus, the uterus is well contracted. The fundus is broad and is at a level little below the umbilicus. It is not freely mobile. If the bladder is empty, a slight supra-pubic hollow is present. It is usually advised to place the left hand just above the fundus until the placenta has been expelled (Plate 52). This is done to control the uterus from rising as a result of filling of the uterine cavity by blood. The chief objection to this procedure is that unwanted kneading and massaging of the uterus by hasty, impatient attendants might precipitate postpartum bleeding. Instead of the hand, a sand bag may be placed just above the uterus to prevent the uterus from rising (Plate 53). In thin subjects, the level of the contracted uterus is clearly seen through the lax abdominal wall and it is not necessary to control the uterus, but in stout women the uterus should be controlled throughout the third stage.

The placenta usually separates in most of the cases within 5-10

minutes of the delivery of the child but it may take as long as 35-40 minutes. Should the placenta not separate within 45 to 60 minutes, the normal mechanism of separation may be considered to have failed and preparations for the manual removal of the placenta should be made. It is extremely important to learn well the signs of separation of the placenta as fruitless vigorous attempts to expel the placenta before it has separated is not only distressing to the patient but is likely to produce postpartum haemorrhage and shock.

When the placenta has separated, the broad fundus becomes globular, often rises a little higher and is freely mobile. The previously observed slight supra-pubic hollow disappears. The umbilical cord does not move when the globular uterus is moved from side to side. Should this happen, a final test for the separation of the placenta is carried out by placing the ulnar border of the left hand just above the symphysis pubis and gently pressing the abdominal wall. If the placenta has not separated, an inch or more of the umbilical cord is pulled into the vagina. The same test can be carried out by placing the fingers above the symphysis pubis and pulling the uterus upwards. Two other signs of the separation of the placenta are: slight gush of blood and apparent lengthening of the umbilical cord. To observe the lengthening of the cord, the cord is ligatured near the vulva (Plates 54, 55). It should be noted that lengthening does not occur in all cases.

When it is definite that the placenta has separated, the uterus is massaged to bring on a contraction and the hard contracted uterus is pressed downwards and backwards to expel the placenta. Sometimes, the placenta, after separation, slides down along the lower segment into the vagina and is expelled by gentle bearing down efforts of the patient.

Nowadays, it has become a routine in many clinics to give 0.25 mg. of ergometrine intramuscularly immediately after the birth of the child. The placenta often separates with the first strong contraction following the injection and the attendant should test for the separation of the placenta within a minute or two of the giving of the injection and, no sooner he is satisfied that the placenta has separated, he should attempt to expel it. This vigilance is necessary because ergometrine sometimes causes annular constriction ring in the lower segment and prevents the expulsion of the placenta. Before the ring forms, he should take the opportunity of expelling the placenta.

When the placenta has come out of the vulva, it is held in both the hands and, in order to remove the membranes intact, they are twisted by turning the placenta round and round (Fig. 50). Another way of delivering the membranes intact is to hold the placenta in both the hands and, by forward and backward swaying movements, successive portions of the membranes appear at the vulva (Fig. 51). When the membranes are adher-

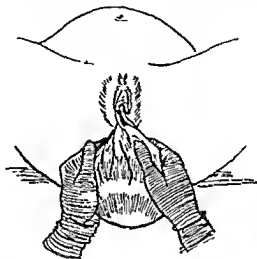


Fig. 50. Method of delivering the membranes by twisting the placenta.

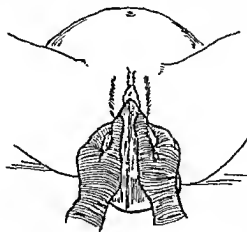


Fig. 51. Method of delivering the membranes by traction with forward backward movements of the placenta.

ent and tend to break away, a swab holding forceps is applied and, by swaying movement and reapplication of a second forceps higher up, successive portions of the membranes appear at the vulva (Plate 56. Figs. 50, 51). The expelled placenta and the membranes are immediately examined. The membranes are turned inside out to expose the maternal surface of the placenta. The placenta is now held in the palms of both the hands and the cotyledons are inspected to observe whether they are close to each other and that there is no gap indicating a missing cotyledon. The membranes should be attached all round the margin of the placenta and show a hole through which the foetus escaped. The two layers, the amnion and the chorion, are closely adherent and that both the layers have been expelled can be observed by separating the two layers along the margin of the hole (Plates 57, 58).

The vulva is washed by pouring antiseptic lotion over it and swabbing it. The perineum and the postero-lateral wall of the vaginal mucous membrane are inspected for external and internal tears. Suturing of the tears should be done immediately after the completion of the third stage to avoid infection of the raw wound. The method of suturing perineal tears and episiotomy incision is described in a later chapter.

As a rule, there is very little bleeding after the expulsion of the placenta but, if blood continues to trickle, it may be due to collection of blood clots in the uterus or due to tears higher up in the vagina or in the cervix. The uterus is massaged to bring on a firm contraction and the blood clots are expelled by firm pressure over the uterus. The bleeding should cease immediately but, if the trickle of blood continues, the upper part of the vagina and the cervix are inspected for lacerations. A Sim's speculum is inserted and the soft-flabby cervical rim is held by four sponge holding forceps applied in 12, 3, 6 and 9 o'clock positions. It is only then possible to visualise cervical tears or lacerations of the vault of the vagina.

Following a normal labour, the pulse slows down considerably and is between 60-70 per minute. The attendant should not be alarmed at this slow rate of pulse; on the contrary, it indicates normal circulatory adjustment following the closing down of the placental circuit. A fast pulse, if it was previously normal, may be due to excessive postpartum bleeding, or shock and exhaustion after a prolonged labour. Blood pressure should be recorded particularly when there is tachycardia.

The vulva and the neighbouring area of soiled skin are cleaned

and a sterilized pad is applied. To prevent the uterus rising from collection of blood clots in its cavity, a roller pad is placed just above the fundus and a tight abdominal binder is applied. The soiled clothes of the patient are changed and she is covered by a clean sheet. If she desires, a hot drink is given to her and she is kept lying flat on her back for two hours after delivery.

The patient is kept in the labour ward under observation for two hours after delivery. The attendant should keep a watch on the pulse and blood pressure, and be on the look out for bleeding.

CHAPTER 6

ANALGESIA DURING LABOUR

The stress of present day life has altered the ways of living and is, in a way, reflected in the demand for relief of pain during labour. The present day existence in the economically developed countries of the West has definitely lowered the threshold for pain and the demand for relief of pain during labour is understandable. Another reason for the demand for analgesia by women of better economic status is that their approach to pregnancy and labour is beset with fear and tension. In the economically underdeveloped countries like India, a comparable demand is observed in the women of upper social class. The women of lower income group are glad to be mothers and their threshold for pain is high. Consequently, during labour there is very little demand for analgesia by these women.

The evolution of analgesics during labour commenced with the beginning of the present century. The first drug employed was morphine alone. Soon after, 'twilight sleep' became the vogue. Twilight sleep is a form of analgesia in which repeated doses of scopolamine are given with one or more injections of morphine. With the introduction of pethidine hydrochloride and barbiturates, the popularity of twilight sleep waned. A recent advancement is the use of chlorpromazine group of drugs alone or in combination with pethidine.

An analgesic to be of value, should not only relieve the pain of labour but should also not have any adverse effect on the mother or the foetus. Unfortunately, most of the analgesics rapidly cross the placental barrier and are found in high concentration in the foetal blood. The risk involved for the mother and the child should be balanced against the gain in relief of pain. After the overenthusiasm that followed the introduction of these drugs, the pendulum has now swung in Western countries, particularly in America, from the use of analgesics to psychoprophylactic preparation, hypnosis and like methods.

Morphine. It is the oldest analgesic drug to be used in obstetrics. Its action is threefold. It relieves pain, induces sleep and allays the feelings of anxiety and fear. It should not be given too

early in the first stage. When regular uterine contractions, occurring every 5 minutes and lasting for 30 seconds, have been established, $\frac{1}{4}$ gr. of morphine should be injected. A second dose of $\frac{1}{3}$ gr. can be given 6-8 hours after the first dose. It should not be given as a first or as a repeat dose after the cervix is three-fourths or more dilated, lest the respiratory depressant action produce a state of asphyxia in the newborn.

Twilight Sleep. It was a very popular analgesic method some years ago but, due to the advent of recent drugs, it is less frequently employed now. Twilight sleep is a combination of morphine and repeated doses of scopolamine. When uterine contractions are well established and the cervix is effaced and two fingers' dilated, $\frac{1}{6}$ gr. of morphine is injected with $\frac{1}{150}$ gr. of scopolamine. An hour later, a second injection of $\frac{1}{200}$ gr. of scopolamine is given. Thereafter, further injections of scopolamine are given as required, judged by the state of amnesia produced. If the woman remembers well what is going on around her, a further dose of $\frac{1}{300}$ gr. of scopolamine is given. With two doses of scopolamine, and certainly after the third dose, the patient drops off to sleep; only during pain she groans or moves a little from side to side.

The drawbacks of twilight sleep are that she needs continuous supervision. The face flushes, the conjunctivae get congested and dryness of the throat is complained of. Frequently, cooperation of the patient during the second stage is difficult to obtain and the incidence of operative delivery is increased.

Barbiturates. They are hypnotics and have very little analgesic action. They act by producing relaxation from tension and elimination of fear. They have therefore to be combined with some other analgesic drug. Barbiturates with short or moderate duration of action, such as sodium amytal or sodium seconal, are preferably used so that the respiratory depressant action on the newborn may be minimum, especially if a general anaesthetic is given during the second stage. They are useful during the early part of the first stage as a substitute for the former bromide and chloral mixture. Their great disadvantage lies in the uncontrollable mental excitement seen in some of the cases.

Tranquillisers. The most widely used tranquillising drugs belong to the promazine group. These drugs differ from hypnotics in that their action is in the subcortical regions, primarily in controlling emotions. As these drugs are not analgesic in action, they have to be employed in combination with other drugs. The most

widely used combination is with pethidine. Like pethidine, these drugs have an antispasmodic action and the dose of pethidine is substantially less when promazine derivatives are combined with it.

The chief drawback of promazine derivatives is fall in blood pressure. In pre-eclamptic toxæmia, these drugs have a useful place. The effects of hypotension become more serious when anaesthesia is employed during the second stage, or in cases of excessive blood loss, or obstetric shock.

Pethidine Hydrochloride. Pethidine is a synthetic compound. During labour, it is injected intramuscularly. Its analgesic action on the central nervous system is comparable to that of morphine. It has also a weak, atropine-like effect on smooth muscle. A dose of 100 mg. of pethidine approximates, in potency, 1/6 gr. of morphine. The duration of its action is shorter than morphine because the drug is rapidly inactivated by the liver. It crosses the placental barrier rapidly but, when used alone, the respiratory depressant effect on the foetus, after a single dose of 100 mg., is negligible even when delivery occurs within 1-2 hours after its injection. But, when a total of 400 mg. or more has been given or, when it is used in combination with barbiturates, asphyxia of the newborn is more likely.

The introduction of pethidine can be rightly claimed as an important advance in obstetric practice. It is universally acknowledged as the analgesic drug for use during labour. Besides its analgesic and hypnotic action, it has a relaxing action on the cervix. The dilatation of the cervix is frequently dramatically rapid, particularly in multiparae. In inco-ordinate uterine action, it needs to be given repeatedly every 4-6 hours and as much as 400 mg. may be safely given during 24 hours without any untoward effect to the mother or the foetus. It is frequently combined with an oxytocic drip and the combination of oxytocic action on the uterus and the relaxing action of pethidine on the cervix reduces considerably the duration of labour.

The only unpleasant side-effect, in some cases, is persistent nausea and vomiting. A dose of 10 mg. of a promazine preparation helps in alleviating the nausea and in enhancing the effect of pethidine. Even in the absence of nausea, 10 mg. of promazine reduces the further dosage of pethidine. A combination of pethidine and promazine is better than a combination of pethidine and barbiturate because promazine has a tranquilising action while barbiturate, at times, produces uncontrolled excitement.

Nitrous Oxide. Some years ago, nitrous oxide was a popular form of analgesia in labour. To maintain adequate oxygenation, inhalation is allowed only during uterine contractions as then safe concentration of 50 per cent nitrous oxide in air is maintained. Prolonged inhalation during and in between uterine contractions reduces the oxygen concentration to 10 per cent. As nitrous oxide crosses the placental barrier rapidly, prolonged inhalation will produce anoxaemia in the foetus. For obstetric use, Minnett's apparatus is employed.

Trichlorethylene. It has a greater analgesic value than nitrous oxide as its use does not require any reduction in the oxygen supply to the patient. Trichlorethylene is inhaled only during contractions. Two or three deep breaths are taken at the commencement of a contraction and a fair degree of analgesia is produced. More prolonged inhalation, besides having the danger of producing foetal anoxia, has also the disadvantage of losing the cooperation of the patient in bearing down efforts.

Psychoprophylactic Preparation of Pregnant Women

Prenatal preparation of the pregnant woman is the principal measure of psychoprophylaxis for approaching labour. Prenatal preparation imparts to the woman peace of mind during pregnancy and especially upon admission to the hospital for parturition. Fear and tension are conspicuously absent.

The principles underlying psychoprophylactic preparations are:

- (1) Create in the pregnant woman a new attitude towards labour as a physiological function which does not at all have to be attended by pain. It should be explained to her that the genital organs, taking part in childbirth, not only increase in size but also somewhat change in structure which ensure parturition in the best possible way.

- (2) Rid the pregnant woman of the possible fears connected with her forthcoming labour and acquaint her in a simple manner some details of labour. By this way, she will create in herself the interest of observing during labour the phases which were explained to her during the prenatal preparation.

- (3) Teach the pregnant woman to execute the so-called pain prevention techniques. These techniques are divided into two groups: (1) obstetrically "neutral", that is techniques which do not directly assist labour, and (2) obstetrically "purposeful", that

is techniques which directly favour the physiological process of labour.

The obstetrically "neutral" techniques aim at, so to say, tuning up the cerebral cortex. These techniques are utilised during the first stage of dilatation. All that is expected of the woman during this stage is relaxation. Stroking the lower half of the abdomen combined with deep breathing helps in producing mental and physical relaxation during this period of waiting.

The obstetrically "purposeful" techniques come into play during the second or expulsive stage of labour. These techniques include the most rational position of the woman's body, proper breathing during the straining efforts, proper tension of the abdominal muscles, relaxation of the voluntary muscles in the interval between the straining efforts, etc.

The pregnant woman must be taught to exercise the newly acquired knowledge and skill. She will thus be actively interested and will realise that it is absolutely necessary and beneficial to follow all instructions.

Psychoprophylactic preparation is best commenced at the 32nd week and the course completed two weeks before the expected date of delivery. The object of completing the preparation two weeks earlier is to allow for miscalculation and earlier onset of labour. If parturition extends to full term or beyond, the ensuing weeks are used for a repeat course. Repetition plays an important part in retaining the techniques taught to her.

There are practically no contraindications for psychoprophylactic preparation of pregnant women except serious mental cases. Healthy women with proper physiological pregnancy are prepared according to a definite general plan. On the other hand, pregnant women with pronounced functional diseases of the nervous system and those having associated systemic medical diseases or obstetric pathology have to be prepared differently to suit the individual peculiarities, though the main principles of the psychoprophylactic method are retained. The reader will appreciate that in a text book of this nature it is not possible to go into the details of psychoprophylactic preparation and only the general outline of the course is given.

First Session. The woman is explained the objectives of preparation. After this introductory talk, the obstetrician should answer in a simple way all the questions he may be asked by the woman.

The first session is predominantly medical and each patient is individually questioned. Information about former labours is important. Previous difficult labours, besides having obstetric significance, have value regarding the psychic trauma that may have been caused.

After taking detailed history, the patient is examined for her obstetric conditions and for general systemic diseases.

Second Session. After the customary individual obstetric examination, the session is conducted in groups of six women. The following subjects are explained: (1) structure of the female sexual organs and the changes occurring during pregnancy, (2) delivery at term, (3) general idea of the stages of labour, and (4) painlessness of physiological parturition. Illustrative charts and diagrams are of great help.

Third and Fourth Sessions. *Preparation for First and Second Stages of Labour.* Signs of onset of second stage are explained. Instructions are given regarding utilising, to the best advantage, the 'bearing down' pains. These include: (1) the position of the body, (2) the training in closing the glottis, (3) holding the breath, (4) practice in straining, (5) behaviour during the passage of the head, and (6) the placental stage.

CHAPTER 7

MECHANISM AND MANAGEMENT OF VERTEX PRESENTATIONS

British obstetricians have described four varieties of vertex presentations according to the direction of the occiput to the left and in front (L.O.A.-V1), the right and in front (R.O.A.-V2), the right and posterior (R.O.P.-V3), and the left and posterior (L.O.P.-V4), and described the mechanism and management of anterior vertex presentations separately from posterior presentations. Statistical data then showed that occipito-anterior presentations comprised roughly 70 per cent of cases, and in the remaining 30 per cent, the presentation was either occipito-transverse or occipito-posterior. As many of these patients were not examined vaginally until late in labour, a considerable number of cases, which were initially occipito-transverse or occipito-posterior, had already rotated into the anterior positions at the time of internal examination, and the incidence of engagement of the occiput in the transverse or posterior position was never properly realised. German writers, from the beginning, described vertex presentations as left and right without distinguishing between anterior and posterior positions and it appears that their grouping was clinically more sound.

Though the great majority of cases of occipito-transverse or occipito-posterior position spontaneously rotate into the anterior position during labour, there are roughly 10 per cent of cases which fail to rotate and pursue an abnormal course. Up to now, textbooks generally described the mechanism of anterior positions of the vertex as normal presentations and the mechanism and management of posterior positions under abnormal presentations. As a result of epoch making radiological studies by Caldwell and Moloy, the female pelvis has been classified into four main types according to its shape. It has been shown that the space available in the fore and hind parts of the pelvic inlet dictates the anterior or posterior position of the occiput during engagement. In fact, Caldwell and Moloy found that, in 60 per cent of the cases, the occiput was actually lateral or transverse at the time of engagement. Rotation of the occiput, anteriorly or posteriorly, also depends, to a great

The first session is predominantly medical and each patient is individually questioned. Information about former labours is important. Previous difficult labours, besides having obstetric significance, have value regarding the psychic trauma that may have been caused.

After taking detailed history, the patient is examined for her obstetric conditions and for general systemic diseases.

Second Session. After the customary individual obstetric examination, the session is conducted in groups of six women. The following subjects are explained: (1) structure of the female sexual organs and the changes occurring during pregnancy, (2) delivery at term, (3) general idea of the stages of labour, and (4) painlessness of physiological parturition. Illustrative charts and diagrams are of great help.

Third and Fourth Sessions.. Preparation for First and Second Stages of Labour. Signs of onset of second stage are explained. Instructions are given regarding utilising, to the best advantage, the 'bearing down' pains. These include: (1) the position of the body, (2) the training in closing the glottis, (3) holding the breath, (4) practice in straining, (5) behaviour during the passage of the head, and (6) the placental stage.

brim is the longest diameter and the head engages with the occiput directly forward or backward. The head passes through the pelvic cavity in the same position.

In the platypelloid pelvis (flat pelvis), the transverse diameter at the brim is the longest and the head therefore engages in the transverse diameter. Once the head passes through the brim there is no difficulty in its passage through the pelvic cavity. Forward internal rotation usually occurs.

Abnormal Uterine Action. Both, 'hypotonic' uterine action and 'hypertonic' uterine action are frequently associated with occipito-transverse or occipito-posterior position. In the presence of weak uterine action, the deflexed head frequently fails to engage and, eventually, requires caesarean section. Frequently, a head that has descended in the mid cavity in the most suitable position in relation to the shape of the pelvis fails to rotate because of weak uterine contractions.

~ *Mechanism of Forward Rotation of Occiput.* Apart from 1-2 per cent of cases in which the head enters the pelvic brim with the occiput in the midline anteriorly and passes through the pelvic cavity in the same position, in all other cases internal rotation of the occiput from its oblique or transverse position must occur for labour to progress.

When the head engages in one or the other oblique diameter of the brim with the occiput forward, internal rotation in the pelvic cavity through 45° brings the occiput in the midline anteriorly. When uterine action is feeble internal rotation in the pelvic cavity may not be brought about and a midcavity or a low forceps is required after manually rotating the occiput to the front.

In the platypelloid pelvis, the head engages in the transverse diameter of the brim. When the antero-posterior diameter of the brim is adequate, the head descends in this position into the pelvic cavity without any difficulty, but, when there is narrowing of the antero-posterior diameter, the head finds difficulty in passing through the brim. The head then attempts to negotiate by bending of the neck sideways. When the neck bends towards the posterior shoulder, the anterior parietal bone descends, while the posterior parietal bone is firmly pressed against the promontory. As a result, the anterior shoulder is readily palpated on abdominal examination. On vaginal examination, the sagittal suture is palpated close to the promontory. As the anterior parietal bone is lower than the posterior, it is known as *anterior parietal presentation*. It

is also known as *anterior asynclitism*, or as *Naegele's obliquity*. After the anterior parietal bone has passed along the pelvic surface of the symphysis pubis, the posterior parietal bone negotiates the promontory, the neck straightens and the sagittal suture comes into the midline. In rachitic flat pelvis, there is overhanging of the promontory and this is the usual mechanism by which the parietal bones pass through the pelvic brim (Fig. 52).

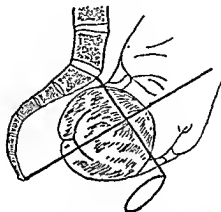


Fig. 52. Diagram showing anterior parietal presentation.

Less frequently, the parietal bones negotiate the brim by a process reverse to the one described above, that is the posterior parietal bone descends, the anterior remaining firmly pressed against the symphysis pubis. The neck bends towards the anterior shoulder and the sagittal suture points towards the symphysis pubis. This mechanism is known as *posterior parietal presentation* or *posterior asynclitism*, or *Litzman's obliquity* (Fig. 53).

Mechanism in Posterior Rotation of Occiput. The rotation of the head into the hollow of the sacrum from the transverse or the occipito-posterior position is nature's adaptation of the head to the shape and size of the midpelvic plane. It is not to be considered as abnormal because, in most of the cases, spontaneous vaginal delivery in the face-to-pubis position results.

In the anthropoid pelvis, the antero-posterior diameter at the brim being the longest diameter, the head may engage with the occiput directly posterior. It passes through the pelvic cavity in the same position and spontaneous delivery in the face to pubis position is to be expected.

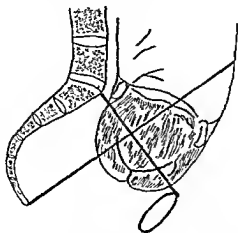


Fig. 53. Diagram showing posterior parietal presentation.

When the head engages in the transverse diameter of the brim and descends in the same position upto the midpelvic plane, rotation of the occiput forward under the symphysis pubis or backwards into the hollow of the sacrum will depend on the available room in the anterior and the posterior segment of the mid-cavity. In android pelvis, there is more room in the posterior segment and the head has a great tendency to rotate backward into the hollow of the sacrum. In fact, were forward rotation to occur in these cases, there would be serious obstruction to labour. Kenny is of the opinion that in android pelvis with a narrow bispinous diameter, the incidence of occipito posterior position is 13 times greater in a primigravida than in those women who have a normal bispinous diameter.

Mode of Delivery. The head is born in one of two ways. Should the head become markedly flexed, the part in front of the anterior fontanelle impinges under the symphysis, after which the occiput is born by further flexion. Then by extension, the brow, the nose and the face are born (Fig. 45).

When the head is partially extended, the root of the nose comes under the symphysis pubis and by flexion, the brow, the bregma and the occiput are born and, finally, the face slips out from under the symphysis pubis by extension of the head.

Extensive lacerations of the perineum are likely to occur as the vulva is distended by the comparatively larger suboccipito-frontal or occipito-frontal diameters. A liberal episiotomy is, therefore, necessary.

Diagnosis

Abdominal Examination. When the back is posterior, the abdomen appears flattened in the centre with bulging of the flanks. This altered contour is more noticeable in multigravidae having lax abdominal walls than in primigravidae. On palpation, the partly deflexed head feels broad. In primigravidae, non-engagement of the head at term is frequently due to the posterior position of the occiput. Unlike in anterior positions where the limbs are palpated on the side opposite to that of the back, in posterior positions the limbs are palpated on both the sides of the midline. This is again more readily detected in multigravidae, and frequently even limb movements are visible through the lax abdominal wall. The back is palpated as a uniform, firm surface in one or the other flank. The palpation of the anterior shoulder, at least $3\frac{1}{2}$ inches away from the midline, confirms the posterior position of the back. The foetal heart sounds are heard right out in the flank on the side of the back. Frequently, the foetal heart is also audible anteriorly on the side opposite to the posteriorly situated back, and the inexperienced, relying on the heart sounds only, is apt to consider the position of the back as anterior.

Vaginal Examination. Unless posterior position of the back has been evident from abdominal palpation, it is not easy to diagnose a posterior position until the cervix is nearly half dilated. The diamond-shaped anterior fontanelle is then palpated anteriorly on one or the other side. The sagittal suture is felt going obliquely backwards to the posterior fontanelle.

When labour has been prolonged and a caput has formed, the sagittal suture and the fontanelles are obscured and it is frequently not possible to be sure of the position until a thorough examination is carried out under anaesthesia with the whole hand inserted into the vagina. Palpation of the ear and the direction of the convexity of the pinna indicates the posterior position of the occiput. When the palpation of the ear fails to indicate the position, the hand is pushed up further, and the palpation of the landmarks of the face indicates the position of the occiput.

Management. During Pregnancy. Posterior position of the back diagnosed before the 36th week should be ignored. In multigravidae, with a previous good obstetric history, posterior position of the back does not require any attention until after the onset of labour. In primigravidae, however, attempt should be made to

ed above, internal rotation frequently commences only after the head has descended to the level of the ischial spines and in a number of cases when it has descended to a level below the ischial spines.

The conventional time factor of allowing the second stage to continue for two hours in a primigravidae and an hour in a multigravidae is of relative value and should not be adhered to strictly in every case. The most important deciding factor is whether labour has come to a standstill by the head neither descending further nor internal rotation of the head taking place. When uterine action is poor, a relatively slower progress is to be expected and the second stage is allowed to continue much longer than the conventional duration. On the other hand, when there is little or no progress in the presence of good uterine action, it is necessary to interfere earlier.

Causes of Arrest. Uterine Inertia. For descent and internal rotation, adequate uterine force is necessary. Delay and failure of rotation, even through one-eighth of a circle, in vertex 1 and 2 in the second stage is frequently due to inadequate uterine contractions. When the descent of the head occurs in the transverse diameter, or obliquely as occipito-posterior, weak uterine contractions are frequently responsible for failure of longer internal rotation.

Deflexion of Head. It is not uncommon for the head to engage in the deflexed position but, when uterine action is good, the head is fully flexed soon after the onset of labour. But, if the deflexion of the head persists due to an arm being under the chin or hypotonic uterine action, the head may fail to rotate.

Type of Pelvis. In an android type of pelvis, the subpubic arch is narrow, the side walls are converging and the sacrum tends to incline forward towards the ischial spines. An android pelvis is, therefore, likely to cause arrest of the head when the head is in occipito-posterior or in occipito-transverse position.

Management. The management of a persistent occipito-posterior or a persistent transverse position will depend on the station

of the head. Generally speaking, when the head is above the mid-pelvic plane, caesarean section is the method of choice, but when the head has descended to or below the level of the ischial spines, vaginal delivery by manual rotation and forceps extraction or rotation and extraction by Kielland's forceps is usually possible. It is preferable to make all preparations for a caesarean section before attempting vaginal delivery so that, should attempts to deliver vaginally fail, a timely caesarean section can be immediately performed.

In neglected cases where the foetus is moribund or already dead, perforation of the head and extraction is necessary.

Manual Rotation. The treatment of choice for the head in deep transverse arrest is manual rotation and forceps extraction. For this purpose, the patient is fully anaesthetised and placed in the lithotomy position, and the whole hand is inserted into the vagina. The introduction of the whole hand allows a more thorough examination than could be made by only two fingers. An estimate is first made of the level of the foetal head in relation to the bony pelvis. The degree of flexion is estimated by noting the position of the fontanelles and the sutures.

Next, the sinciput is pushed up by the fingers. This not only increases flexion but also makes rotation easier. The occipital region is now grasped in the palm of the hand and the head rotated. The other hand is placed on the anterior shoulder through the abdominal wall so that the shoulder is also rotated with the rotation of the head. With both the hands working in unison, an attempt is made to rotate the whole foetus. Rotation applied to the head alone will not rotate the trunk, and the failure of the trunk to rotate means mere twisting of the neck with the return of the head to its original position on relaxing the grip.

Kielland's Forceps. It is a long forceps which is not easy to apply except by one who has made himself well acquainted with its use. The blades grasp the head accurately and do not let it slip off. The blades are guided into position, one anteriorly behind the symphysis and the other in front of the sacrum. The head is thus gripped symmetrically in the bi-parietal diameter. The head is drawn down to the pelvic floor and is then rotated so as to bring the occiput forward. Frequently, the head spontaneously rotates forward during traction.

When the sacrum is flat and the posterior segment of the pelvic cavity is shallow, the head which has descended in the occipito-

lateral position cannot rotate normally because its lateral aspect is closely applied to the flat sacrum. If the pelvic cavity is wide enough transversely, there is usually more space for rotation at a lower level. The head should, therefore, be drawn down into the outlet by means of Kielland's forceps before the occiput is rotated forward.

Instead of the Kielland's forceps, Barton's forceps is useful in some cases. If the sacrum is straight, Barton's forceps is likely to be more successful than Kielland's and vice versa when the sacrum is curved.

When the outlet is narrow as in a funnel-shaped pelvis, the arrest should have been anticipated and a caesarean section should have been done early in labour. Even if this condition is first diagnosed late in labour when the head is impacted deep in the pelvis, caesarean section is still the best treatment, although symphysiotomy might be considered.

SECTION V

DISORDERS PECULIAR TO PREGNANCY

CHAPTER 1

ABORTION

Abortion denotes termination of pregnancy before the 28th week of gestation. Until recently, the term abortion was applied to the expulsion of the ovum before the 12th week and the term 'miscarriage' was employed when the ovum was expelled between the 12th to the 28th week.

Incidence

The incidence of abortion can never be accurately gauged for several reasons. Many early abortions pass unnoticed by the patient who considers it merely a delayed menstruation. An estimate of the incidence in the general population from the hospital statistics is inaccurate, as cases admitted to the hospital are mostly emergencies, and spontaneous abortions without much bleeding remain unreported. From the case histories of women attending the gynaecological outpatients department, it is found that, in nearly 50% of married women, there is a history of one or more previous abortions.

Abortions occur more frequently in multiparae than in primiparae, but this higher incidence is relative, as there is always a larger number of multiparous women as compared to primiparous.

There is usually a higher incidence of criminal abortions in cities, and that is because the socio-economic stress in urban areas demands limitation of family. All over the world the rate of criminal abortions is on the increase, and this unhealthy trend has been aggravated by the safety afforded to the abortionist by antibiotics.

Etiology

The etiology is so complex, that a cause can be found in not more than 20% of the cases. In many cases, more than one cause

is responsible for the abortion. In the early weeks of pregnancy, abortion is frequently preceded by the death of the ovum. When the ovum is expelled soon after its death, an embryo is usually present in the expelled conceptus, but when the dead ovum is retained in the uterus for some length of time, the embryo is frequently completely absorbed, and is not found in the expelled contents.

In abortions occurring after the 12th week, the foetus is frequently in a fresh state and alive, and abortion is then due to some factor which causes premature uterine contractions.

The various etiological factors have been grouped as follows:

- (1) Causes which result in foetal death.
- (2) Causes in the uterus which interfere with, either the development, or nutrition of the ovum.
- (3) Endocrine imbalance.
- (4) Psychogenic factors.
- (5) Cervical causes.

Causes Which Result in Foetal Death

Defective Germ Plasm. In recent years, it has been established that the most frequent cause of abortion in the early months is fertilization with a chromosomically defective ovum or spermatozoon. The grossly defective embryo perishes during the early weeks of gestation, and the dead ovum is then expelled by the uterus. Should such an ovum develop beyond 12 weeks, a malformed foetus continues to form until term.

Acute Infectious Diseases. Small pox, measles and other acute viral infections are common in the tropics, and the death of the foetus occurs as a result of high temperature. The likelihood of abortion is still greater when foetal anoxia occurs due to associated cyanosis.

Chemical Poisons. Quinine, lead, arsenic and mercury, sometimes have a lethal action on the ovum. The effect of these drugs on a pregnant uterus is however variable, and even very large doses given as abortifacients are very often ineffective in causing expulsive contractions.

Syphilis and Rh Incompatibility. These two conditions seldom cause abortions. Spirochaetes fail to cross the placental barrier before the 24th week. Sufficient Rh antibodies do not usually appear in the foetal circulation until after 28 weeks.

Destruction of corpus luteum by irradiation, or its surgical removal before the 12th week, leads to abortion.

Causes in Uterus Which Interfere with Nidation Or Growth of Ovum

Malformations of Uterus. The two horns of a bicornuate uterus are frequently unequally developed, and when conception occurs in a poorly developed horn, the uterine musculature is unable to stretch beyond 14 to 16 weeks, and the conceptus is aborted. In a septate uterus, early abortion occurs when the ovum embeds on the poorly developed decidua over the septum.

Maldevelopment of Uterus. In a hypoplastic uterus it is not uncommon to see one or more early abortions before a pregnancy is carried to term. Sometimes, the hypoplasia is so marked, that the uterus is unable to stretch, and there are repeated abortions before the completion of the second month.

Retro-displacement of Uterus. In this country, many obstetricians still believe retroversion of the uterus as an important cause of abortion; but this is contrary to the present view in other countries. About 20% of women have congenital retroversion, and most of them conceive and go to term. The question of correcting retroversion arises only in those few who have either symptoms of a threatened abortion, or have had recurrent abortions in the 3rd or the 4th month. When symptoms of a threatened abortion are present, it is unwise to correct the retroversion, as the manipulations needed to correct it are more likely to aggravate the abortion. With a history of recurrent abortion, the retroverted uterus should be corrected by gentle manipulation, and kept in position by a suitable pessary, soon after the first period has been missed. When a hypoplastic uterus is retroverted, the cause of the abortion is hypoplasia, and reposition is mainly co-incidental. It is, therefore, evident that an operation for the correction of a retroverted uterus is seldom necessary.

Fibromyomata. The influence of fibromyomata in causing abortion is variable, and depends more on the situation of the growth than on their number. Subserous or superficial intramural growths do not, as a rule, disturb pregnancy. When an ovum gets embedded on or near a deep intramural or submucous growth, a very early abortion occurs which is frequently considered by the patient as a delayed profuse menstrual period. When a fibro-

myoma is pelvic in situation, it may get impacted during the 3rd month and cause an abortion.

Endocrine Imbalance

Endocrine function stimulates the growth of the endometrium, its glands, stroma and its vascular bed as preparation for the nidation of the ovum. For this preparation the corpus luteum is undoubtedly responsible, and the progesterone failure at this stage results in a very early abortion frequently confused with a profuse, delayed period. The chorion, soon after its formation, produces hormones similar to those of the corpus luteum, and the role of the corpus luteum loses its prime importance, even as early as the 3rd month of gestation. After the 12th week, the corpus luteum has no role in maintaining conception. It can, therefore, be concluded that corpus luteum is vital for the first two months of gestation, and then gradually its role is taken over by the hormones produced by the chorion. It is during this transitory period of the change over of the function from the corpus luteum to the chorion, that imbalance is likely to result in an abortion. The frequency of abortion during the 2nd and the 3rd months is partly due to this imbalance. It was at one time believed that excess of oestrogen over progesterone stimulated uterine contractions; but recent work shows that both oestrogen and progesterone are necessary for sustaining the ovum for the first few weeks, until the chorion, and later the placenta, take over this function.

Psychogenic Factors

It is not an uncommon clinical observation that profound grief, fear, anger, or such other unpleasant emotional disturbance frequently precipitates an abortion. The manner in which abortion is brought about is not known, but it is probable that direct stimuli from the hypothalamus stimulate uterine contractions. The intimate relationship between the adrenals and the central nervous system may also have some causal influence.

Relation to Menstruation. Statistical data reveals that a number of abortions during the first three months occur round about the dates of the expected period. It is therefore advisable to avoid sexual and emotional excitements during these days—especially when one or more early abortions have previously occurred.

Coitus. Coitus during the early weeks sometimes stimulates expulsive uterine contraction. Whether abortion is brought about by local trauma to the uterus, or emotional excitement, is not known. Trauma to the uterus may be indirectly through the movement of the cervix, or directly upon the body of a retroverted uterus.

Cervical Causes

The two important cervical causes are: (1) Previous deep lacerations or high amputation of the cervix, and (2) incompetency of the internal os. In both, repeated abortions occur after the fourth month.

A deeply lacerated cervix can be satisfactorily treated by a properly performed trachelorrhaphy, but when a high amputation for an elongated cervix has been previously performed the cervix is flush with the vaginal vault. Repeated abortions after the 4th month occur, for which nothing can be done.

Incompetency of the internal os as a cause of late abortions has been recently stressed by Shirodkar and others. Normally, the internal cervical os withstands the intra-amniotic pressure which increases as pregnancy advances. An incompetent internal os fails to do this, and opens up during the second trimester of pregnancy, following the protrusion and finally the expulsion of the foetal sac.

In some, the incompetency may be due to previous excessive dilatation of the cervix for some gynaecological indication, but in many, the incompetency is not due to local injury, but is a developmental anomaly.

A convenient clinical grouping of the various causes described above is summarised below:

I. Before 6 weeks:

- (i) Germ plasm defect.
- (ii) Marked hypoplasia of the uterus.
- (iii) Corpus luteum deficiency.
- (iv) Defective embedding of the ovum (a) on a septum of a malformed uterus, (b) on deep intramural or submucous fibromyoma.

II. After 6 weeks and before 12 weeks:

- (i) Mild hypoplasia of the uterus.
- (ii) Germ plasm defect—vesicular mole and other gross malformations.

- (iii) Uterine displacements—incarceration of retroverted or laterally flexed gravid uterus.
- (iv) Incarceration of a gravid uterus, with a fibromyoma or ovarian cyst impacted in the pelvis.

III. *Causes common upto 12 weeks of gestation:*

- (i) Acute specific infections.
- (ii) Sudden emotional upset.
- (iii) Indiscretions such as strong purgatives, coitus and vigorous exercises.

IV. *Between 12 weeks and 24 weeks:*

- (i) Malformation of uterus (bicornuate uterus).
- (ii) Incompetency of the cervix.
- (iii) Early infarction of the placenta in cases of malignant hypertension.

V. *After 24 weeks:*

- (i) Placenta praevia.
- (ii) Placental infarction in malignant hypertension.
- (iii) Premature rupture of membranes.
- (iv) Habitual death of foetus of unknown origin.

Clinical Types of Abortion

The following clinical types are recognised:

Threatened abortion.

Inevitable abortion.

Incomplete abortion.

Complete abortion.

Missed abortion.

Septic abortion.

Recurrent (habitual) abortion.

Therapeutic abortion.

Induced (criminal) abortion.

It is customary to discuss the clinical features and the management of the different types of abortion separately, but it must be realised that the different types are merely different stages of the same process. A *threatened abortion* is the earliest stage of the process, which is often arrested, and the pregnancy reaches term.

With further progress of this early threatening process, a stage is reached when abortion becomes inevitable. When the conceptus is expelled as a whole, it is termed complete abortion; but when a part of the foetus, the placenta or the decidua remains in the uterus, it is called incomplete abortion. Should the fragments remaining inside get infected, it is called infected, septic, abortion. When the entire conceptus after its death or detachment is not expelled for a length of time, it is known as missed abortion.

Threatened Abortion

Whenever slight uterine bleeding occurs in the presence of amenorrhoea, it should be considered as a 'threat' to abort until it is diagnosed that the woman is not pregnant. It is not uncommon to have slight bleeding at about the time of the first missed period, and this frequently recurs at about the same time each month, for the first two or three months. To start with, the bleeding is slight, and the longer it persists the greater are the chances of abortion becoming inevitable. In favourable cases, the bleeding is soon replaced by a brownish discharge which indicates that further detachment of the ovum has been arrested, and that the old blood remaining in the uterus is now trickling out. As a rule, 70 to 80% of the cases of slight bleeding of short duration continue their pregnancy undisturbed, but even slight bleeding is unfavourable, when one or more previous abortions of about the same term have occurred.

Slight lower abdominal pain or backache is present in some cases. The occurrence of intermittent colicky pain carries an unfavourable prognosis, and indicates that uterine contractions are attempting to expel the ovum. Another unfavourable sign is the passing of small clots or blackish discharge for a number of days; it usually indicates that the ovum has perished, and abortion is inevitable.

Diagnosis. First and foremost it is necessary to confirm pregnancy as bleeding following amenorrhoea might be due to some gynaecological disorder. When the pregnancy has advanced to 12 weeks or more, the uterus can be palpated per abdomen but, when it is of lesser duration, a vaginal examination will be necessary. When the uterus is enlarged in proportion to the term of amenorrhoea, and is *soft* to the feel, it usually means that the foetus is still alive. In a threatened abortion that is progressing favourably, the

cervix is closed and its shape is unaltered. Whenever a bright red discharge continues for more than a few days, it is necessary to do a speculum examination, as a vascular erosion or a small cervical polyp may be the cause of the bleeding.

Biological Test in Prognosis. Even though the bleeding is slight, it is futile to continue the expectant line of treatment for more than a few days, and a pregnancy test must be performed. If the test is negative, the uterus should be evacuated as soon as possible. If the test is weakly positive, it indicates that the conceptus has perished, and that the test will become negative during the next few days. A strongly positive test after bleeding of several days is of favourable prognosis, but the test should be repeated again after two weeks to ascertain the progress.

Management. Treatment of threatened abortion is most unsatisfactory and uncertain. Complete rest in bed, preferably in an institution away from household and other emotional disturbances, is the most important part of the treatment. Rest, as frequently understood by the patient, is just staying at home, but medically, rest means not even sitting up in bed for passing urine, stool or for taking meals. Strict rest in this way should be continued for a week after bleeding has stopped.

Sedatives help by relieving the anxiety of the patient, but whether they have any direct action of relaxing the uterus is not known. Initially, morphia $\frac{1}{4}$ grain, or Omnopon $\frac{1}{3}$ grain is given. Further sedation is continued by giving some barbiturate or meprobamate preparation orally.

Indiscriminate use of progesterone, merely on the assumption that it is deficient, is illogical, and its administration should be guided by vaginal cytology and, if possible, by estimation of the excretion of pregnanediol in the urine. The presence of 30% keratinised cells in the vaginal cytology indicates progesterone deficiency, and indicates progesterone therapy, but when more than 50% of vaginal cells are keratinized, it is futile to give progesterone as the abortion is almost certainly inevitable. Again, when excretion of urinary pregnanediol is less than 5 mg. in 24 hours, progesterone therapy is indicated. The frequency and dosage of progesterone should be guided by repeated observation of vaginal cells. Either 250 mg. of a long-acting preparation of progesterone is given weekly, or a daily dose of 25 mg. of the usual preparation is administered. The recently introduced nor-ethisterone may be used instead of progesterone.

Preparations, containing Rutin, vitamins K and C, are usually given for arresting further bleeding, but they are of doubtful value.

Vitamin E was advocated on the basis of increased abortion rate in vitamin E deficient rats, but it has not proved its utility in humans.

When the abortion ceases to threaten, the patient is advised to avoid hard domestic work, emotional or sexual excitement, and to be particularly careful during the days of the expected menstruation until the pregnancy is successfully carried to 16 weeks.

Inevitable Abortion

When there is no chance whatsoever of retaining the conceptus, abortion is inevitable. Two clinical types are seen: in one, the process is sub-acute, in the other it is acute.

Sub-acute Type. In the sub-acute case, the initial slight bleeding increases in the course of a few days, and small clots are passed with continuous dull lower abdominal pain and backache. On vaginal examination, the cervical canal admits the finger. Frequently, the external os is tightly closed, but the vaginal portion of the cervix is barrel-shaped indicating that the internal os and the cervical canal have already dilated. Abortion has now become inevitable, but, if evacuation is not done at this stage, profuse bleeding and severe colicky abdominal pain follows sooner or later.

Acute Type. In this case, without any warning, profuse bleeding occurs and large clots are passed with severe colicky abdominal pain. If the entire ovum is rapidly expelled, the pain and bleeding subside. Frequently, there is a partial separation, resulting in severe bleeding with fall of blood pressure, rapid pulse and other signs of collapse. The cervix is already dilated to allow one finger, and, frequently, part of the ovum is felt protruding through the cervix. At times, the uterus is disproportionately enlarged to the term of amenorrhoea and that is due to the collection of blood and blood clots in its cavity.

Management

In the sub-acute type, diagnosis may be confirmed by the preponderance of keratinised cells on vaginal cytology. As the general condition of the patient is satisfactory, pethidine, 100 mg.,

is injected, and a pitocin drip, containing 10 units in one pint of 5% glucose solution is administered at the rate of 30 to 40 drops a minute. Alternatively, pitutrin may be given in half-hourly doses of 5 units each. If this treatment fails to expel the ovum, preparations are made for evacuation of the uterus. Intravenous sodium thiopentone or general anaesthesia is given. In many cases the cervix is sufficiently dilated, but, if it is not, it is dilated by metal dilators. Digital evacuation should always be aimed at, but if a finger cannot be passed through the cervix, a blunt curette is used. When the uterus is more than 12 weeks' size, evacuation by a curette is dangerous as the soft uterus might easily be perforated. In any case, ergometrine or Methergin, 1 c.c., should be given just before commencing evacuation to contract the uterus. This reduces blood loss during the operation, and the contracted uterus is less likely to be perforated.

In the acute type, the process of expulsion is hastened by giving a pitocin drip as described above. The expelled ovum should be carefully examined. If a complete ovum is passed, the bleeding and pain subside.

When the patient has collapsed, active measures to improve her general condition should be taken before undertaking evacuation. Generally, in a collapsed patient the bleeding, as a result of fall in blood pressure, becomes temporarily negligible but, if bleeding continues, rapid digital evacuation must be done immediately. As the cervix is dilated, evacuation is easy, and is done without anaesthesia. Even when the expelled ovum appears to be complete, it is advisable to do a gentle curettage to remove the remaining fragments of the chorion and the decidua.

Incomplete Abortion

Small or large fragments of chorionic tissue remaining in the uterine cavity give rise to blood stained discharge, or bouts of irregular bleeding which may continue for weeks or months until the uterus is evacuated.

Clinical Features. An incomplete abortion has varying clinical features as given below.

In many incomplete abortions, only the foetus and part of the chorion are expelled. Bleeding continues to occur from the portion left behind in the uterus. It is easily diagnosed as the uterus remains bulky, and the products can be felt or seen to protrude through the dilated cervix.

If a case of spontaneous abortion, which apparently appeared to be complete, continues to have slight blood-stained discharge for several weeks, it indicates that small fragments of chorionic tissues and the thick decidua are still remaining in the uterine cavity. The uterus is only slightly enlarged, and the cervical canal is patulous.

An incomplete abortion is sometimes mistaken for dysfunctional uterine bleeding, and the true nature of it is diagnosed by finding chorionic villi on histological examination of the eurented material.

When the adherent chorionic tissue remains for a long time in the uterus, it becomes organised, and a fibrous mass is formed around the chorionic fragments. It is then known as a placental polyp. Continuous blood stained discharge and bouts of irregular bleeding at intervals persist for months or even years. A placental polypus simulates a chorionic carcinoma, and only a negative biological pregnancy test on urine and cerebrospinal fluid excludes the latter possibility. In the absence of a proper history, it is also mistaken for a fibromyomatous polyp.

Management

The management of abortion, once it has become inevitable or incomplete, has undergone considerable modification in recent years. The former concept that an inevitable or incomplete abortion will ultimately evacuate itself has been replaced by surgical evacuation of the uterus soon after it has become evident that the abortion is inevitable or incomplete. The great disadvantage of the former concept is that prolonged hospitalization is necessary as natural evacuation sometimes takes days or weeks and not infrequently fails. Besides, there is always the possibility of infection of the retained products.

When the cervix is dilated and the patient is bleeding, a digital evacuation is performed immediately. In all other cases, dilatation of the cervix and curettage is required.

A placental polyp can also be eurented out but profuse bleeding is likely to occur during the removal. Frequently, as the condition is mistaken for a fibroid polyp, a vaginal or abdominal hysterotomy or hysterectomy is performed and the correct diagnosis is arrived at only after opening the uterine cavity.

Complete Abortion

Expulsion of the entire products of conception completes the process of abortion. The cervical canal now closes and the bleeding is negligible. Active treatment is not needed any more (Plates 59, 60).

Missed Abortion

When a dead ovum is retained in the uterine cavity for several weeks, it is called a "missed abortion".

Pathology. The pathology of missed abortion, occurring before the formation of the placenta and the obliteration of choriodecidual space, is different from that occurring after the development of the placenta.

In a missed abortion, occurring before the 12th week, a blood (carneous, fleshy) mole is formed. Upto this period, there is a narrow space all round the ovum between the chorion and the decidua (Plate 61). This choriodecidual space is traversed by delicate chorionic villi which are attached by their tips to the maternal decidua. For some unknown reason, slight bleeding starts from the maternal vessels, and extravasates into the choriodecidual space. The broadening of the space by the collected blood, tears the attachment of the delicate villi to the decidua. Repeated slight haemorrhages into the different parts of the choriodecidual space, cut off the nutrition of the ovum received from the villi, and the embryo dies. In time, the entire ovum is surrounded by clotted blood, into which the detached chorionic villi can be seen on histological examination. The amnion is not destroyed, and on section of the mole, an intact, greyish white, amniotic cavity can be seen. In many cases, the embryo is completely absorbed, and no trace of it can be found in the amniotic cavity (Plates 61, 62). In others, a small embryo attached to the amnion can be seen. The size of the amniotic cavity is frequently disproportionately large as compared with the size of the embryo (Plate 63). A mole that has been retained for many weeks appears 'fleshy' as a result of organisation of the blood surrounding the amniotic cavity. In rare instances, there is a deposition of calcium salts in the blood clots around the ovum which gives rise to a 'stony' mole.

A specimen of missed abortion occurring after the 16th week shows a disproportionately large placenta as compared with the

size of the foetus. This is because the placenta continues to develop for some time after the death of the foetus. The placenta is tough, and is of a red or waxy appearance. The amniotic sac is loose and wrinkles as a result of the absorption of liquor amnii. The foetus is macerated, dropsical, or even mummified according to the length of time it has been retained. The decidua becomes thick and vascular.

Clinical Features. The clinical history of 'missed' abortion is characteristic in most of the cases. After a period of amenorrhoea of some weeks, there is slight vaginal bleeding for a few days which is followed by mucoid, tarry discharge. The uterus ceases to grow and gradually reduces in size. In some cases, besides amenorrhoea, there are no other symptoms. As the uterus may shrink almost to its normal size, it is likely to be diagnosed as secondary amenorrhoea. The correct diagnosis is arrived at by histological examination of the curettings. Sometimes, the persistence of amenorrhoea, after cessation of symptoms of threatened abortion, is considered as normally progressing pregnancy and, later, when the correct diagnosis of missed abortion is made, it comes as a disappointment to the patient.

When the foetus dies after pregnancy has progressed upto or beyond 16 weeks, regressive changes in the breasts will be noticed by the patient. If 'quickening' has already occurred, the subsequent absence of foetal movements makes the patient seek medical advice. The uterus will cease to grow, and its size will get progressively smaller as weeks go by. The elastic feel of the uterus is replaced by a firm consistency; and this change is an important sign of foetal death. Soon after foetal death, there is a slight bleeding for a few days, followed by a black tarry discharge. A negative biological pregnancy test confirms the diagnosis of a "missed abortion".

Management. There is no urgency to evacuate a missed abortion. As a rule, spontaneous evacuation occurs within 2-3 weeks after foetal death, but if it does not occur within four weeks, it is advisable to attempt evacuation by medical measures or by surgical methods. Prolonged waiting for spontaneous evacuation has its disadvantages. There is always more than usual bleeding during evacuation, and the longer one waits the greater the chances of a brisk haemorrhage. Until recently, the haemorrhage was considered to be from the thickened decidua, but recent knowledge brings in the possibility of hypofibrinogenaemia as the cause of it.

As in concealed accidental haemorrhage, thromboplastin, absorbed into the maternal circulation from the collected blood, results in hypofibrinogenaemia. It should, however, be remembered, that the likelihood of hypofibrinogenaemia complicating a case of missed abortion arises when the dead ovum is retained for more than 7 weeks.

High Concentration Oxytocin Drip. Loudon, in 1959, advocated high concentration oxytocic intravenous drip in the management of missed abortion. A pint of 5 per cent dextrose solution, containing 10 units of oxytocin, is started and by additions of oxytocin the concentration is increased. In a recent case of missed abortion of 20 weeks treated by the author, the inert uterus started contracting after 4 pints of dextrose solution, each containing 35 units of oxytocin.

Surgical Evacuation. As brisk haemorrhage is likely during evacuation, blood should be kept ready. When the uterus is of less than 10 weeks' size, dilatation and curettage is easily performed, but the evacuation of a uterus that can be palpated per abdomen is likely to prove risky from serious haemorrhage. Medical induction combined with pitocin drip should be tried repeatedly. As hypofibrinogenaemia is unlikely to occur, until at least 7 weeks after the foetal death, it is prudent to wait for the uterus to reduce in size before deciding upon surgical evacuation.

Septic (Infected) Abortion

Infection of the aborting uterus and its contents are referred to as septic abortion. In most cases, a septic abortion follows criminal interference by abortionists; but, sometimes, the woman herself attempts to induce an abortion by passing instruments, sticks or irritating drugs into the cervix (Plate 64). Usually the abortion is incomplete. It is uncommon for a spontaneous incomplete abortion to get infected and, even when infection occurs, it is mild.

Causal Organisms. Investigations have shown that in about one-fifth of the cases of incomplete abortion having no clinical evidence of infection, a variety of organisms can be cultured from the vagina and the cervix. Even *Clostridium Welchii* is found in some cases. The bacteriological report has therefore to be interpreted in relation to the clinical features.

The commonly occurring organisms of low virulence are, the coliform bacilli, Staphylococci, and non-haemolytic streptococcus.

These organisms usually cause a localised infection of the endometrium.

The dangerous organisms are the streptococcus haemolyticus, *Cl. Welchii* and *B. tetanus*. They cause a generalised infection which often proves fatal.

Mode of Entry. Apart from the occasional endogenous infection from the normally present organisms in the vagina and the cervix, the infecting organisms are from some exogenous source in most of the cases. The commonest source is any infected article used by abortionists for inducing criminal abortion.

Clinical Features. *Mild Localised Endometritis.* The infection is from organisms of low virulence, and a regular protective barrier of leucocytes in the deeper parts of the endometrium limits the infection to the retained products, and the superficial layer of the endometrium.

The temperature is not usually high and the toxicity is low as observed from the mild tachycardia and normal blood pressure. Profuse purulent vaginal discharge is the most characteristic sign. The uterus is bulky but not particularly tender, and there is no tenderness or inflammatory mass in the pelvis. A speculum examination should be done, as injury to the lower genital canal may have occurred as the result of passing instruments or other objects.

Virulent Infection. When the infection spreads to the adnexa and the pelvic cellular tissue, it remains localised to the pelvis and recovery occurs with permanent morbidity in the form of sterility or chronic pain. Pelvic abscess rarely occurs nowadays due to the routine free use of antibiotic drugs. The formation of a pelvic abscess is indicated by the continuous, daily evening rise of temperature, the onset of tenesmus, and sometimes, retention of urine. It takes several weeks for an abscess to "point", and it usually points towards the pouch of Douglas, and can then be opened by posterior colpotomy. Occasionally, a cellulitic abscess points on the lower abdominal wall.

Virulent infection by streptococcus haemolyticus frequently becomes generalised, causing peritonitis, ileus, or septicaemia. High temperature with rigors, markedly rapid pulse of low volume, abdominal tenderness and distension, mental distress, a tender bulky uterus, and slight blood stained, non-offensive lochia, indicate a severe infection. Previously, such virulent infection almost always ended fatally, but the energetic use of various antibiotic

drugs has considerably altered the outlook now. But, even then, a number of late cases prove fatal.

Management. The management of the abortion depends on the nature of the infection. Evacuation of the infected contents was never undertaken formerly, until the infection was controlled and the temperature had remained normal for several days for fear of the spread of infection. Since the last few years, this trend has been considerably modified.

Today, mild cases of infection localised to the endometrium are treated by evacuation of the uterus, soon after admission. An initial dose of 1,000,000 units of penicillin is given, and the uterus is evacuated digitally or by a curette, irrespective of the patient bleeding or not. The curettage must be gentle, as otherwise the protective barrier of leucocytes in the deeper layers of the endometrium will be destroyed. By this way, the incidence of permanent occlusion of the cornual ends of the tubes, as also the likely spread of the infection along the lymphatics to the pelvic tissues, is reduced.

When the infection has already generalised, immediate evacuation of the septic products is not of any practical value, and all efforts must be directed towards controlling the infection. The question of evacuation arises only after the infection has been controlled. The only exception would be of a case bleeding badly when first seen.

Gas Gangrene Infection. Infection by the clostridium group of organisms is extremely grave and spreads rapidly.

The usual cause is intrauterine paste or other drugs used by the abortionist or by the patient herself.

Toxaemia is profound, and marked prostration is a characteristic feature. The symptoms may commence within 12 hours. The pulse becomes rapid and thready. The skin is cold and clammy, and signs of peripheral failure are present. Lower abdominal pain with signs of generalised peritonitis rapidly sets in. Haemolytic anaemia is a characteristic feature, and jaundice develops very soon. Suppression of urine, due to either ischaemic cortical necrosis or due to the tubules getting blocked by blood casts, is a grave complication, and the small quantity of urine that is secreted is of a port wine colour due to the presence of blood pigments. On taking a radiograph, gas in the uterine cavity may be seen, and is a useful evidence of gas gangrene infection.

Treatment. The main principles in the treatment are to combat toxæmia, to treat the rapidly occurring hæmolytic anaemia, and to treat suppression of urine.

To combat toxæmia, 1,000,000 units of penicillin combined with 100,000 units of anti-gas gangrene serum are given intravenously. This initial treatment is followed by giving 1,000,000 units of penicillin combined with 50,000 units of anti-gas gangrene serum intravenously every few hours until the infection is controlled. 3,000 units of anti-tetanus serum are given intramuscularly as prophylaxis.

A venesection is preferably done, and a very slow drip of 5% dextrose solution is given. In the presence of anuria, the amount of intravenous fluid should be reduced to a minimum. Transfusion of packed cells is necessary to combat the hæmolytic anaemia. Anuria is a very grave complication and its treatment is given under acute renal failure.

Habitual (Recurrent) Abortion

When three or more successive pregnancies have terminated in abortion at about the same period of development, there is a good reason to believe that a recurrent cause is in operation. As a rough clinical estimate it may be stated that the chances of a second pregnancy continuing to term after one abortion are 75 per cent; after two abortions, 50 per cent; after three abortions, 25 per cent; after four abortions, 10 per cent.

Recurrent causes before the 12th week of pregnancy are: (1) genital hypoplasia, (2) ovular defects, (3) repeated incarceration of a retroverted or laterally flexed uterus, (4) hyperthyroidism, (5) hormonal imbalance.

The recurrent causes after the 12th week are: (1) malformations of the uterus (bicornuate uterus), (2) incompetency of the cervix, (3) malignant hypertension, (4) untreated diabetes, (5) blood incompatibility.

A case of recurrent abortion must be thoroughly investigated for a recurrent cause. Even then, it is not always possible to detect a cause in a large number of patients.

Genital hypoplasia can be made out on clinical examination, and the future prognosis depends on the degree of hypoplasia. Those with marked hypoplasia usually abort within two weeks of a 'missed' period, and frequently, the patient considers such episo-

des as delayed profuse periods. They are unfortunate examples of repeated disappointments, and usually have a life long sterility. Those with mild hypoplasia have one or two abortions before the third month, but usually the third or the fourth pregnancy goes to term.

Ovular Defects. When a woman has a successive second abortion, the ovum should be carefully studied for embryonic malformation. Hertig and Rock studied 100 cases of repeated abortions, and found 43% as due to ovular defects. In many, the same causative factor is detected in consecutive specimens. A good example is repeated molar pregnancies.

Incarceration of a retroverted or laterally flexed uterus is an occasional cause, and ventral suspension is required. The obstetrician should not assume that successive abortions are due to the malposition of the uterus, unless he has attended the previous abortion, and ascertained incarceration as the cause of it.

Hyperthyroidism should be excluded, by estimation of the basal metabolic rate, blood cholesterol, and serum iodine.

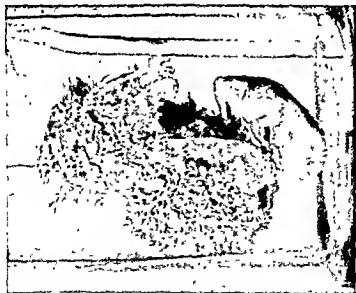
Hormonal Imbalance. A repeated vaginal cytology during the first few weeks should be done for progesterone deficiency, and when the deficiency is detected, prolonged progesterone therapy is likely to continue the pregnancy to term.

Malformations of Uterus. A hystrogram should always be done to exclude a bicornuate or a septate uterus. Way found 2 cases of septate uterus among 12 cases of repeated abortions investigated by hystrogram. Occasionally, a hystrogram may accidentally detect a 'filling defect' due to a submucous fibromyoma.

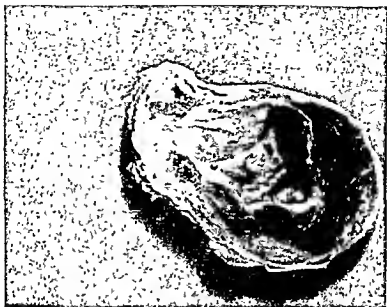
Incompetency of Cervix. A history of painless abortion preceded by a profuse milky white discharge is a useful guide. Various methods of confirming incompetency of the os in the non-pregnant state have been practised, but the only reliable test is observation of the incompetency during a previous abortion by a competent obstetrician. The other methods suggested are: passage of a No. 8 Featon's dilator without any resistance from the internal os, and hystero-graphy. Incompetency of the internal os can be overcome by placing a ligature round the cervix at the level of the internal os as described by Shirodkar. Silk, merse-lene, dacron, and fascia lata strips are the various ligature materials used for the purpose. This tightropeing of the internal os can be undertaken even during pregnancy.



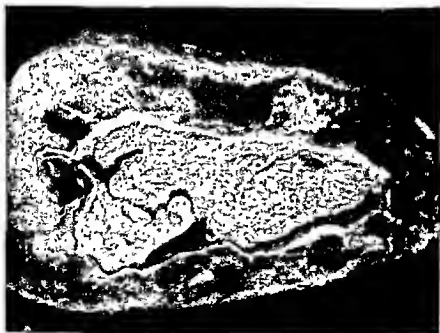
Pl-59. Specimen showing complete abortion (Courtesy: N. W. M. Hospital Museum, Bombay) (p. 178).



Pl-60. Specimen showing complete abortion; a ten-week-foetus is seen attached to the ruptured sac. (Courtesy: N. W. M. Hospital Museum, Bombay). (p. 178).



Pl-61 Vertical section of a carneous (fleshy) mole The amniotic sac is surrounded by blood clot (Courtesy. N W M Hospital Museum, Bombay).
(p 178)



Pl-62. Vertical section of a carneous (fleshy) mole. A tiny foetus is seen one end of the amniotic cavity. (Courtesy: N. W. M Hospital Museum, Bombay) (p. 178).



Pl-63. Vertical section of a carneous (fleshy) mole. The amniotic cavity is disproportionately large as compared with the size of the foetus. (Courtesy: N. W. M. Hospital Museum, Bombay) (p. 178).



Pl-64. Three varieties of foreign bodies recovered from septic (criminal) abortions. (Courtesy: N. W. M Hospital Museum, Bombay). (p. 180)

Malignant hypertension is, occasionally, a cause of repeated abortion, usually after the 24th week. An unrecognised diabetes or untreated diabetes can be the cause of repeated abortions.

Psychogenic Factors. Many women who have aborted previously become apprehensive from the early weeks of a subsequent pregnancy. This apprehension, after two or three successive abortions, is sometimes so marked, that a number of women try to avoid a pregnancy. These women need psychological support from the attending obstetrician. We have, on many occasions, succeeded in carrying a subsequent pregnancy to term, merely by giving a course of penicillin injections during the third, fifth and seventh months. To start with, courses of penicillin were given in the belief that recurrent abortions might be due to latent syphilis, but, latterly, we have replaced penicillin by vitamin B complex injections, and have found them equally successful. Such supporting measures are worth a trial, and from an experience of the last ten years, we firmly believe, have a place in the management of cases of recurrent abortions in whom a thorough investigation fails to detect a recurrent cause.

Therapeutic Abortion

Therapeutic abortion is indicated whenever the associated systemic disease of the mother is likely to prove fatal if pregnancy is allowed to continue. It is also indicated whenever a viral disease, contracted during the first twelve weeks, is likely to cause serious congenital maldevelopment of the foetus in utero.

With recent advances in medical therapy and close liaison between the obstetrician and the physician, therapeutic abortion is nowadays seldom indicated. The limited present-day indications for therapeutic abortion are: (1) Early carcinoma of the cervix, (2) malignant hypertension, (3) German measles contracted before the end of the third month, and (4) neurological diseases. Association of pregnancy with advanced cardiac disease, tuberculosis and diabetes used to be important indications some years ago, but today pregnancy can be allowed to go to term without serious deterioration to the health of the mother.

Therapeutic abortion should be undertaken by the obstetrician only after joint consultation with another medical colleague and his approval of the measure. The question of sterilizing the patient at the same time should be carefully reviewed.

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CHAPTER 2

HYDATIDIFORM MOLE

Definition. Hydatidiform mole is an abnormal proliferation of the epithelial covering of the chorionic villi, with hydropic degeneration of the avascular stroma of the villi.

In the past it was considered to be a degenerative process, hence the name 'vesicular degeneration of the chorion'; but that was because the proliferation of the epithelial layers was disregarded. Clinical and pathological evidences suggest it as a benign neoplasm of the chorion. In support of the view that hydatidiform mole is a new growth is the fact that the epithelial lining has the potentiality of becoming malignant, and developing into chorion epithelioma.

Incidence. Hydatidiform mole appears to be 8 to 10 times more common in Asia than in the Western countries and America.

The causes of high incidence of vesicular mole in Asian countries are, according to Acosta-Sison: (1) Deficiency of high class proteins, like milk, meat and eggs, in their diet. It does not appear to be a racial characteristic because among the Orientals the high incidence of hydatidiform mole is observed in the poor hospital patients, whose diet consists mostly of rice and fish, and not among the well-to-do private patients. (2) A relative factor is that hydatidiform mole occurs much more frequently in multiparae and it is not uncommon in the Orientals to have many rapidly succeeding pregnancies; as a result, the incidence is raised by the large numbers of multiparae in statistical studies.

In United States, Hertig reports an incidence of 1 in 2000 pregnancies. In United Kingdom, Ian Donald gives an incidence of 1 in 200.

The highest incidence is reported by Acosta-Sison from Philippines. During the Japanese occupation in the Second World War, the incidence was 1 in 126 pregnancies. To ascertain whether the high incidence during the War was due to gross malnutrition, a second survey was made by the same author from January 1955 to September 1957 which showed the incidence to be 1 in 200 pregnancies.

Hasegawa, from Japan, reported an incidence of 1 in 232 and King, from Hongkong, 1 in 530 pregnancies.

From India, Bhaskar Rao from Madras reported an incidence of 1 in 361, Das from Calcutta 1 in 147, and Daftary, Chhatre and Masani from Bombay 1 in 505 pregnancies.

Age. The incidence of hydatidiform mole increases with age, more particularly after the age of 40. Many authentic cases of hydatidiform mole in women as old as 55 have been recorded. In the N. W. M. Hospital series of 93 cases, 58 (62.3) per cent occurred in the age group 15-25 years and 35 (37.7) per cent in women above 35 years.

Pathology. The simultaneous hydropic degeneration of the mesodermic core and proliferation of the epithelial layers, according to Hertig, is due to certain developmental conditions. The mole formation begins from the third to the fifth developmental week, when the fetochorionic circulation is normally established. In pathologic ova, fetochorionic circulation is not established, resulting in degeneration of the mesodermic core. The trophoblast, on the other hand, continues to live, and remains functionally active because it is nourished by the maternal blood in the intervillous space.

As the degenerative changes in a complete mole commence before fetochorionic circulation has been established, the embryo is absent. If the mole continues to grow for several weeks, a vesicular mass of enormous size is formed. The cysts are of varying size and are held together by stems of connective tissues. A big cluster of vesicles, resembling a bunch of large ripe grapes, together with small withered grapes, is formed (Plates 65, 66).

Hydatidiform mole is usually complete, but a number of cases have been reported in which hydatidiform changes are restricted to a small portion of an otherwise normal placenta, a condition not incompatible with the development of a foetus. The foetus survives as long as circulation from the normal portion of the placenta is adequate for its growth. The author reported a case in 1935 where pregnancy continued upto 8 months.

Cases of partial hydatidiform mole have occurred in the placenta of uniovular twins, with the survival of one of the twins (Plates 67, 68).

Microscopic Structures. The three characteristic histological changes are: (1) Hydropic degeneration of the villous stroma, (2) scantiness of blood vessels in the degenerated villous stroma,

and (3) proliferation of both the epithelial layers of the trophoblast (Plate 69).

Stroma. The villous space is dilated due to marked oedema and degeneration. The remains of the stroma are flattened out and compressed against the walls of the villous, leaving a large central space filled with clear fluid. The fluid is, more or less, similar in composition to ascitic fluid. Here and there a few nuclei are seen.

Epithelial Changes. Both, the syncytium and the Langhan's cell layers proliferate. The histological appearance of sections taken from vesicles expelled from the uterus, and from vesicles still attached to the uterus, differs. Whilst there is almost complete absence of trophoblastic activity in sections taken from expelled vesicles, sections from the vesicles still attached to the uterus show proliferation of both the epithelial layers. Trophoblastic activity is absent in those vesicles which have undergone degenerative changes as a result of their having grown away from their blood supply in the uterine wall.

Chorionic Gonadotrophins. Langhan's cells produce gonadotrophin which enters the maternal circulation from the pool of slowly circulating blood in the intervillous space. It should be emphasised that in early pregnancy high values of chorionic gonadotrophins are present in the blood serum and urine and the peak is reached at about 60 days after the last menstruation, when it may be as high as 600,000 I.U. Thereafter, the titre decreases and at 100 days the titre is rarely above 20,000 I.U. In view of high values during the third month of normal pregnancy, the diagnosis of hydatidiform mole by bioassay is unreliable before three months from the last menstrual period. The titre is likely to be higher in twin pregnancy than in single pregnancy, and the fall to low levels is slightly slower.

When the blood level of chorionic gonadotrophins is high, it is found in the cerebrospinal fluid. Formerly, its presence in the cerebrospinal fluid was regarded as diagnostic of hydatidiform mole or choriocarcinoma. Recently, however, it has been shown that chorionic gonadotrophins are sometimes absent in the cerebrospinal fluid in hydatidiform mole, and that, occasionally, they are found in normal pregnancy.

Ovarian Changes associated with Hydatidiform Mole. Owing to overstimulation of lutein elements by large amounts of chorionic gonadotrophins, lutein cysts of the ovaries are formed in many

cases of hydatidiform mole. They may be on one or both the sides, and may be microscopic, or as large as an orange. These lutein cysts store chorionic gonadotrophins (Plate 70).

Clinical Features. In molar pregnancy, hyperemesis is apt to be more severe and persistent than in normal pregnancy.

Hypertension and other signs of pre-eclampsia are frequently observed in molar pregnancy. They develop when the uterus has attained six months' size, and this usually occurs about the 12th to the 14th week of gestation. Usually, pre-eclampsia occurs in the third trimester, and the onset of these symptoms in the second trimester are suggestive of a molar pregnancy. The combination of pre-eclampsia and disproportionate enlargement of the uterus is sometimes diagnostic of molar pregnancy.

Low grade rise of temperature is seen in a fair number of cases, and the temperature persists until the mole is evacuated.

As long as the mole remains completely attached to the uterine wall, it grows luxuriantly and enlarges the uterus disproportionately to the term of amenorrhoea. Acosta-Sison found the uterus to be larger than the age of gestation in 70.7% of cases. In 11.4%, the size corresponded to the term of amenorrhoea, and in 17.9% it was smaller than the age of gestation.

Around the fourth month, the mole begins to separate from its uterine attachment, and vaginal bleeding commences. The bleeding may be slight, bright red or brownish, and may occur for several weeks. Such bleeding is frequently mistaken for threatened abortion especially when the uterus is not convincingly larger than the age of gestation.

In some cases, after 'spotting' for a few days, profuse vaginal bleeding occurs due to sudden partial detachment of the mole, and the patient becomes gravely shocked.

Diagnosis. Clinically, a molar pregnancy comes under observation in several ways.

(1) **Intact Mole with No Vaginal Bleeding.** The patient having amenorrhoea of 2-3 months considers herself normally pregnant, and attends the prenatal clinic for a routine check up, when a suspicion is aroused from the disproportionate enlargement of the uterus to 5-6 months' size. In an uterus enlarged nearly up to the umbilicus, foetal parts can be palpated in a normal pregnancy by external ballotment, but in a molar pregnancy no foetal parts can be palpated. The disproportionate enlargement could also be due to a mistake in menstrual calculation, hydramnios, or multi-

ple pregnancy and, when foetal parts cannot be palpated per abdomen, a vaginal examination should be done to feel foetal parts by internal ballotment. Due to the absence of amniotic fluid in a molar pregnancy, the uterus feels doughy on abdominal palpation.

(2) Slight Vaginal Bleeding due to Commencing Separation of a Mole. The slight bleeding is often mistaken for threatened abortion and the diagnosis is sometimes delayed for several weeks. It should be remembered that the uterus is, at times, disproportionately enlarged in cases of abortion due to intra uterine collection of blood clots. On vaginal examination the cervix is dilated and, on careful examination of vaginal discharge, a few vesicles are often found. On inserting the fingers into the dilated cervical canal a few vesicles can always be detached which then confirms the diagnosis of a mole.

When a large portion of a mole abruptly separates, there is profuse vaginal bleeding. The diagnosis of a mole is readily made by examining the discharged material.

(3) Intraperitoneal Haemorrhage from Perforation of Uterus by a Malignant Mole. This is a rare clinical accident. It is usually diagnosed as a ruptured ectopic pregnancy and the correct diagnosis is made only after opening the abdomen.

(4) Separation of Mole with Concealed Intrauterine Haemorrhage. Occasionally, the mole separates without any external bleeding. The blood and the blood clots distend the uterus which may rise as high as the xiphisternum. Circulatory collapse occurs and the diagnosis is difficult unless a molar pregnancy has been previously suspected. This complication closely simulates concealed accidental haemorrhage. The correct diagnosis is usually arrived at laparotomy.

Investigations.

An X-ray film examination should normally reveal a foetal skeleton when the uterus is enlarged upto the umbilicus. Visualisation of a foetal skeleton definitely excludes a molar pregnancy, but absence of a foetal shadow does not necessarily confirm a molar pregnancy. On several occasions, the foetal skeleton was not visualised on first examination, but was seen in a subsequent radiograph.

Biological Test of Urine. Zondek-Aschheim quantitative test is the most reliable. In a normal pregnancy, the chorionic gonado-

trophin value is very high upto 60 days, and falls to a low level after 100 days. Therefore, in a normal pregnancy a positive test in a dilution of 1 in 100 or even higher can occur up to 12 weeks of gestation. For confirming a molar pregnancy, the dilution should be atleast 1 in 200, becoming higher when the test is repeated after a few days. A positive initial test in dilution of 1 in 300 or more is confirmatory of a molar pregnancy.

Abdominal Amniocentesis. Sequeira has elaborated, at the N.W.M. Hospital, a useful clinical test for the diagnosis of hydatidiform mole. A lumbar puncture needle, attached to a syringe, is introduced into the uterine cavity through the abdominal wall under local infiltration with novocaine. The uterine contents are now aspirated. Aspiration of clear liquor amnii confirms a normal pregnancy and conclusively excludes a hydatidiform mole. Aspiration of fresh blood is likely to be due to puncture of the placental site. Aspiration of dark blood is strongly suggestive of hydatidiform mole.

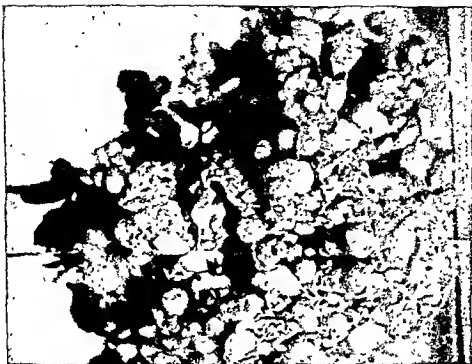
Treatment. Evacuation of the mole is the obvious treatment but the method of evacuation is selected in each case, according to the clinical conditions present. In the majority of cases, vaginal evacuation of the mole is chosen, but there are some cases where an abdominal approach is necessary.

When there is vaginal bleeding of some duration, the cervix is usually dilated. Attempt is made to expel the mole by an intravenous drip containing 10 units of oxytocin in 500 ml. of 5 per cent dextrose solution. If this fails, the cervix is dilated further by metal dilators and digital evacuation or curettage is performed.

In a patient collapsed as a result of severe vaginal bleeding, the os is usually sufficiently dilated to allow digital separation of the remaining portions of the mole, but resuscitative measures by infusion fluids and blood transfusions must be carried out first and when the patient has been retrieved from shock, evacuation is undertaken.

Immediately after digital evacuation of the mole, a gentle blunt curettage is advisable to remove the thick decidua and the few remaining vesicles; otherwise bleeding is likely to continue or severe bouts of bleeding may occur when the decidua separates.

In a mole which is still completely attached to the uterine wall the question of vaginal or abdominal evacuation arises particularly in primigravidae. In such cases, there is no vaginal bleeding, and the cervix is closed.



Pl-65. Specimen of a vesicular mole. Note the large size of the vesicles.
 (Courtesy: N. W. M. Hospital Museum, Bombay) (p. 188)



Pl-66. Specimen of a vesicular mole. Note the small size of the vesicles.
 (Courtesy: N. W. M. Hospital Museum, Bombay). (p. 188).



Pl-67 Specimen of foetal surface of the placenta showing part of the placenta having undergone vesicular change (Courtesy, N. W. M. Hospital Museum, Bombay) (p 188).



Pl-68. Specimen of partial vesicular degeneration of the placenta. Placenta is seen on the right. A small foetus in its sac is seen at the left of the specimen. (Courtesy, N. W. M. Hospital Museum, Bombay). (p. 188).



Pl-69. Photomicrograph of vesicular mole (Courtesy: N. W. M. Hospital Museum, Bombay). (p 189).



Pl-70 Specimen of uterus containing a malignant mole which has perforated the left cornu. Bilateral luteal cysts of the ovary are seen. (Cour Dr. J Jhirad, Bombay). (pp. 190; 197).

VIII A 2



Pl-71 Section of uterus showing a vesicular mole in situ. (Courtesy: N W. M Hospital Museum, Bombay) (p. 193).



Pl-72. Chorionepithelioma of body of uterus. (Courtesy: N. W. M. Hospital Museum, Bombay). (p. 197).



Pl-73. Chorionepithelioma of body of uterus. (Courtesy: N. W. M. Hospital Museum, Bombay). (p. 197).



Pl-77 Metastases of chorionepithelioma in the kidney (Courtesy: N. W. M. Hospital Museum, Bombay). (p 198).

In multiparae, vaginal evacuation is the rule, irrespective of the size of the uterus. The patulous cervix can usually be dilated easily by metal dilators after a preliminary dilatation by insertion of laminaria tents.

In primigravidae, particularly when the cervix is conical, it is difficult to dilate the cervix sufficiently to undertake vaginal evacuation with safety. From an insufficiently dilated cervix, evacuation is unsatisfactory, and the brisk bleeding is difficult to check. It is, therefore, prudent to do a hysterotomy in such cases. Bleeding is negligible and the mole is evacuated under vision.

In multiparous women over the age of 40, who have sufficient number of living children, it is safer to perform abdominal hysterectomy with the mole in situ, to eliminate the chances of a chorionic malignancy developing (Plate 71).

In every case, adequate quantity of blood for transfusion should be kept ready, as severe bleeding is a serious complication.

Complications. (1) *Haemorrhage.* The amount of blood loss during evacuation of a mole is unpredictable. Profuse haemorrhage may occur, and enough blood should be ready to replace the lost blood. Brisk haemorrhage may occur some days after evacuation of the mole, when the thick decidua separates.

(2) *Perforation of Uterus.* Perforation of the uterus may occur during digital evacuation or a curettage. An immediate abdominal hysterectomy should be performed. Perforation of the uterus may occur several weeks or months after evacuation, and that is caused by chorioadenoma destruens, 'perforating mole'.

(3) *Infection.* When evacuation of the mole is delayed, ascending infection of the uterus occurs through the dilated cervix. Previous to the introduction of antibiotics, it used to be a serious complication.

Follow-up. As choriocarcinoma is a very grave disease following a molar pregnancy, its early detection is possible only by periodic follow-up for at least two years after evacuation of the mole. Every patient who has had a vesicular mole should be followed-up every month for the first six months, and thereafter, periodically, every three months for at least two years to detect the development of choriocarcinoma. Normally, vaginal bleeding should stop within a week or ten days. The uterus should become normal in size within four to five weeks. Persistence of bleeding or recurrent episodes of bleeding should always be carefully investigated by uterine curettage, and an A-Z test. At each

follow-up visit, the vulva, the vagina and the cervix should be inspected (by inserting a speculum) for local metastases of choriocarcinoma, which appear as purplish nodules. An x-ray of the chest should always be taken if bleeding persists, or the uterus remains bulky, or pulmonary signs appear. The biological test for pregnancy should become negative within six to eight weeks and, if it remains positive, quantitative tests should be done to note the titre. The biological test should be repeated periodically for atleast one year. The patient should be urged to avoid a pregnancy for at least two years.

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CHAPTER 3

CHORIONEPITHELIOMA

Chorionepithelioma is a malignancy of foetal origin arising from the remains of the embryonic chorion and it thus differs from adenocarcinoma and sarcoma which are malignancies of the tissues of the uterus. It is always preceded by a conception which, in about 50 per cent of cases, has been a hydatidiform mole, and in the remaining 50 per cent an abortion or a full-term pregnancy.

Incidence. Hertig reported from America an incidence of 1 in 40,000 pregnancies. Hasegawa reported an incidence of 1 in 271 pregnancies in Japan. Bhaskar Rao and Shetty reported from South India 27 cases in 79,896 pregnancies, including abortions, an incidence of 1 in 2958. In England, Alan Brews found only 27 cases in the London Hospital Records between 1885 and 1927. The low incidence in America and the Western Countries as compared to the incidence in the East is probably due to the high incidence of molar pregnancies in the Eastern Countries.

Etiology. The incidence of choriocarcinoma following a vesicular mole, an abortion, or full-term pregnancy varies considerably in the different reported series as is evident from the table below.

	Novak & Seah (74 cases)	A. Sison (70 cases)	Bhaskar Rao & Shetty (27 cases)	Alan Brews (27 cases)
Hydatidiform mole	.. 62.85%	39.2%	40.75%	33.3%
Abortion	.. 24.28%	37.8%	40.75%	33.3%
Full-term delivery	.. 10.0%	23.0%	18.0%	16.6%
Nature of conception not known	.. —	—	—	16.8%

According to Acosta-Sison, high incidence of molar pregnancy in the East is due to defective germ plasm giving rise to abnormal development of the villi.

All the statistics regarding the incidence of chorionic carcinoma, following a molar pregnancy, an abortion or a full-term delivery are based on clinical evidence only. There is no histopa-

thological evidence of the nature of the chorionic villi in the previously aborted ova or in the full-term placentae. Since all aborted ova and placentae are not critically examined as a routine, it is open to question whether chorionic malignancy can ever occur in normally developed chorionic villi. It is known that, occasionally, a small part of a placenta undergoes vesicular change, the major portion being so normal, anatomically and physiologically, as to allow conception to proceed to full term with the birth of a normal foetus. Is it not likely that were all aborted ova and placenta thoroughly examined over a long period, partial vesicular change may be found in a few of them? It may then be possible to prove that choriocarcinoma develops only in villi which have undergone a previous vesicular change.

There is still difference of opinion as to whether hydatidiform mole is a degenerative or a neoplastic lesion. Nowadays, there is a greater tendency to regard it as a neoplastic process and the frequent development of chorionic carcinoma after a molar pregnancy is comparable to an innocent tumour later becoming malignant. Nowhere in the body malignancy develops in a degenerative process and it is most unlikely that such a high grade malignancy of the chorion should occur with degenerative vesicular change in the chorion.

Interval between Previous Conception and Onset of Symptoms. In a large number of cases, the interval between the termination of conception and the appearance of symptoms is between one month to one year. In the case reported by Vaze from Bombay, clinical evidence of malignancy appeared 8 days after evacuation of the mole. Gupta, on the other hand, reported a case in which chorionic carcinoma developed 25 years after the last delivery.

Pathology. Ewing, in 1910, classified chorionic tumours according to their histological characteristics into: (1) choriadenoma-destruens or malignant mole; (2) chorionepithelioma or choriocarcinoma, (3) syncytioma or syncytial endometritis. Hertig and Sheldon added one more degree which they called chorionepithelioma in situ. Syncytial endometritis and chorionepithelioma in situ are not considered by most pathologists as true malignant forms because in these conditions there is physiological invasiveness of the early normal trophoblast into the myometrium.

Choriadenoma Destruens (Malignant Mole). The tumour is composed of elongated hypertrophied villi with active prolifera-

tion of syncytial protoplasmic masses and Langan's cells. The villi infiltrate the uterine sinuses and, at times, metastases occur in the broad ligament, the pelvic veins, the vagina and the lungs. An orderly growth of villi is characteristic of this type and it offers a hopeful prognosis. Massive trophoblastic invasion and destruction of uterine muscle does not occur in malignant mole (Plate 70).

Chorionepithelioma. The chief feature is the invasion of the uterine musculature and blood vessels by the trophoblast. On cut section, an irregular haemorrhagic mass infiltrating the musculature is seen in the uterine cavity. The musculature has homogeneous appearance with scattered haemorrhagic areas. In some cases, the growth may be present in the muscle only, in which case there will not be any uterine bleeding (Plates, 72, 73, 74).

Microscopically, columns of trophoblastic cells, syncytial masses, as well as Langan's cells are seen advancing in an irregular manner into the musculature destroying the muscle tissue. In and around the trophoblastic infiltration, haemorrhagic areas from perforation of blood vessels are visible. In places, well-formed chorionic villi may be present (Plates 75, 76).

Syncytioma, described by Ewing, has been recognized by subsequent writers as a typical new growth in which there is an extensive invasion of the uterine muscle by the syncytium. Ewing regarded it more as a regressive type of choriocarcinoma, but others consider it as a new growth in which Langan's cells have disappeared. According to Novak, the term syncytial endometritis is more appropriate because it represents unusual persistence of trophoblastic elements after an abortion or full-term delivery. Clinically, the variety has a benign course, but, occasionally, syncytium perforates the blood vessels causing haemoperitoneum.

Sometimes, histological diagnosis is straightforward whilst at other times it is difficult. There is little difficulty in diagnosis when trophoblastic masses are seen infiltrating the muscle but in border-line cases it is difficult to differentiate between a true chorionepithelioma and a benign hydatidiform mole showing marked trophoblastic proliferation.

Metastases. Unlike carcinoma which infiltrates along the lymphatics, chorionepithelioma spreads by the blood stream. The most common sites of local metastases are the vagina and the vulva. Distant metastases most frequently occur in the lungs. Less frequent sites are the brain, the liver, the kidneys and the

bones (Plate 77). In Novak's series of 74 cases, metastases in the lung occurred in 41, in the vagina in 12, in the brain in 11, in the liver in 7, and in the kidney in 5. In Alan Brews series of 27 cases, 14 cases were autopsied and pulmonary metastases were found in 9, vaginal in 17, and cerebral in 4 cases. In one more living case, vaginal metastases were present. In this series, the incidence of vaginal metastases was over 50 per cent. Vaginal and vulval metastases occur through retrograde transport of the carcinoma cells, while distant metastases and extension to the tube, the ovary and the broad ligament are by the blood stream.

Symptoms. In the majority of cases, the patient continues to bleed irregularly after evacuation of a mole, an abortion or a full-term pregnancy. The bleeding may be continuous or in severe bouts at intervals.

When chorionepithelioma develops during pregnancy, there is irregular bleeding but it remains unsuspected until delivery, following which there is irregular continuous bleeding or severe bouts at intervals.

In about one-third of the cases, offensive discharge from the uterus and irregular fever are complained of. Progressive anaemia is associated in most of the cases.

In some of the cases, secondary metastases predominate the clinical picture. Lung metastases give rise to cough, pain in the chest and haemoptyses, symptoms likely to be mistaken for pulmonary tuberculosis or bronchiectasis. Similarly, haematuria from kidney metastases may confuse the diagnosis. Brain metastases have been diagnosed as apoplexy or brain tumour and at post mortem the correct diagnosis was made.

Physical signs. On vaginal examination, the uterus is found usually enlarged. The surface of the uterus is generally regular. When lutein cyst of one or both the ovaries are palpated, the diagnosis of chorionepithelioma is strongly suggestive. In advanced cases, a foul smelling necrotic mass protruding from the cervix may be present. It is then likely to be mistaken for a sloughing fibroid polyp.

In an occasional case, a small growth is situated deeply in the myometrium. As there is no growth in the cavity of the uterus, vaginal bleeding is absent and the uterus is not appreciably enlarged. It is difficult to diagnose, as curettage will not reveal the presence of the growth.

Diagnostic Aids. *Quantitative Aschheim-Zondek Test.* The

Aschheim-zondek test is preferable to Friedman's test as the former is more suitable for the quantitative estimation of gonadotrophic hormone. Usually, Aschheim-Zondek test becomes negative within a month after a full-term delivery or an abortion, and its persistence after a month in a patient who is bleeding irregularly is to be regarded as suspicious. After spontaneous evacuations of a vesicular mole, the Aschheim-Zondek test may remain positive for as long as two months. A quantitative test in such cases is helpful, as repeated positive tests with increasing dilutions indicate active proliferation of chorionic villi.

Zondek laid stress on examination of cerebro-spinal fluid for the presence of gonadotrophic hormone because with cerebro-spinal fluid the test is negative in normal pregnancy but it is positive in hydatidiform mole and chorionepithelioma.

When Aschheim-Zondek test remains positive a month after total extirpation of the uterus and the adnexa, it is strongly suggestive of distant metastases. Again, it remains positive in the presence of lutein cysts of the ovaries until they regress.

Curettage. Since the introduction of biological tests for chorionic gonadotrophins, curettage for obtaining tissues for microscopic diagnosis is not always necessary. Curettage is a dangerous procedure as the uterine wall may be so thinned out and necrosed by the infiltrating growth that the dilator or the curette may perforate the uterus with severe intraperitoneal haemorrhage. Besides, it is recognized that frequently there is no evidence of the growth in the cavity, the infiltration being in the muscular wall and examination of curetted material in such cases would not be helpful. Digital exploration of the uterine cavity is safe. A growth can be readily palpated and a portion of it removed for histological examination without risk.

In many cases from histological study of the curetted material a preoperative diagnosis of malignancy can be arrived at but a conclusive evidence of malignancy is better determined after histological study of the removed uterus. However, there are cases in which there is no chorio-carcinomatous lesion detected in the uterus even though positive evidence of pulmonary metastases is found on autopsy examination.

Differential Diagnosis. Irregular uterine bleeding, many months after the expulsion of a mole, may be mistaken for dysfunctional bleeding, *placental polyp* or *chronic metritis*.

When the first symptom has been haemoptysis, it has been fre-

quently mistaken for *pulmonary tuberculosis or dry haemorrhagic bronchiectasis*.

With secondary metastases in the brain it has been mistaken from *encephalitis* or even *brain tumour*.

Prognosis. Chorionepithelioma is a highly malignant growth. In a small proportion, about 10 per cent, spontaneous cure occurs and there is regression of the primary growth. The distant metastases have also been known to regress but there have been instances where the primary growth completely regressed but a fatal termination resulted from the metastases. An explanation offered for spontaneous cure is based on the fact that in many pregnant women there are trophoblastic islands in the lungs which are destroyed after delivery by a lytic substance present in the blood and such a lytic substance may possibly be the factor in regression of primary and metastatic chorionepithelioma.

Ewing in 1928 stated that he had been unable to find any record of operative cure of chorionepithelioma. Novak estimates the mortality from 70 to 80 per cent.

Novak reviewed 74 cases of choriocarcinoma in 1954 and found 13 (17.5 per cent) living without recurrence for one year or more, and 3 more survivors living 6 months after the operation. Choriocarcinoma is rapidly fatal, usually within 6 months, and 16 (21.6 per cent) survivals in his series is noteworthy.

Post operative irradiation of the pelvis is not necessary as fatal metastases to distant organs, like the lungs and brain, occur by the haematogenous route.

Treatment. Abdominal hysterectomy offers the only chance of saving the patient's life. In young patients it is not necessary to remove the ovaries because the tumour spreads by the blood stream and not along the lymphatics but, if there are lutein cysts, the ovaries must be removed.

Hysterectomy is not contra-indicated when there are vaginal or vulval metastatic growths. When metastases have occurred in distant organs, such as lungs, liver or brain, panhysterectomy is of doubtful value. It is the opinion of some writers that even in the presence of such distant metastases, panhysterectomy should be performed as it may result in regression of such distant growths. It is usually stated that local vaginal growths regress after hysterectomy, but in one of author's case severe repeated bleeding occurred from the vaginal growths 11 days after hysterectomy. It is,



Pl-78 Extra-tubal rupture. (Courtesy: N. W. M. Hospital Museum, Bombay). (p. 204).



Pl-79. Tubal abortion. (Courtesy: N. W. M. Hospital Museum, Bombay). (p. 205).

therefore, preferable to excise local metastatic growths in the vulva or the vagina after removing the primary growth.

Chemotherapy. The chemotherapeutic drug used is 4-amino-N-10-methylpteroylglutamic acid (Methotrexate). The rationale for the use of Methotrexate, a folic acid antagonist, is the high requirement of folic acid in the rapidly growing foetal-maternal tissues. The drug is administered in 5-day-courses of 10 to 30 mg. intramuscularly or by continuous intravenous drip. It is also given orally as 5 mg. 5 times a day for 5 days. The side effects of the drug are stomatitis, rash, jaundice and gastrointestinal ulceration. As with all chemotherapeutic drugs, there may be initial and acquired resistance.

Bergental et al treated 27 cases of choriocarcinoma and related trophoblastic disease and obtained remissions from 8 to 29 months. As acquired resistance develops after varying periods, it is preferable to apply intermittent therapy to get more prolonged remissions.

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CHAPTER 4

EXTRA-UTERINE (ECTOPIC) PREGNANCY

The term "extra-uterine" and "ectopic" are used for gestation occurring outside the uterus, but ectopic is a more comprehensive term because gestation occurring in the interstitial portion of the tube, though outside the uterine cavity, is still in the uterine wall.

The common sites for ectopic pregnancy are:

- (1) The Fallopian tube.
- (2) The ovaries.
- (3) The rudimentary horn of a bicornuate uterus.
- (4) Primary implantation in the abdominal cavity.
- (5) Secondary implantation in the abdominal cavity.

TUBAL PREGNANCY

Etiology. The etiological factors concerned in the causation of tubal pregnancy are very imperfectly understood.

Many factors have been put forward and warmly supported by different observers, but it can be stated without contradiction that any one factor by itself is seldom responsible for causing ectopic pregnancy.

Factors responsible for causing tubal pregnancy are grouped into: (1) those retarding the progress of a fertilized ovum to the uterine cavity, and (2) those favouring nidation in the tube.

Factors retarding the progress of fertilized ovum are salpingitis, post-operative kinking of the tube, congenital anomalies of the tubes, and external or internal migration of the ovum.

Salpingitis. As a result of previous salpingitis, external adhesions cause distortion and kinking of the tube. During an acute inflammation the mucous membrane of the tube is destroyed in part and the denuded mucous surfaces then adhere to each other and form a network of intratubal adhesions. Loss of ciliary movement is an additional factor. The transportation of the ovum along the tube into the uterine cavity is retarded by these pathological changes and no sooner the trophoblast is developed the ovum

embeds in the tube. Upto 1960, 54 cases of ectopic pregnancy associated with genital tuberculosis have been reported.

Post-operative Kinking of Tubes. Adhesions which form after pelvic operations sometimes kink the tube and retard the progress of a fertilized ovum. Kinking of the tube may also result after ventralsuspension of the uterus.

Congenital Anomalies. There may be a diverticulum of the tube or an accessory ostium into which the ovum is lodged. In congenital hypoplasia the tubes are long, tortuous and the muscular wall is thin, all of which delay the passage of the ovum into the uterine cavity.

External Migration. In this condition the ovum discharged from the ovary fails to enter the tube of the same side but migrates across the pelvic cavity and enters the tube of the opposite side, gets fertilized and embeds in it. External migration is confirmed at operation when the corpus luteum of pregnancy is found on the side opposite to the ectopic tubal gestation. As the rudimentary horn of a bicornuate uterus is usually not connected with the vagina, conception in it can only occur by external migration of the spermatozoa or the fertilized ovum across the peritoneal cavity.

Internal Migration. In this condition the fertilized ovum passes along one tube, enters the uterine cavity but, instead of getting embedded there, it travels across and enters the opposite tube and gets embedded into it. Conception into a tube which has its fimbrial extremity previously occluded can only occur by internal migration of the ovum.

Condition favouring nidation in the tube are endometriosis and decidual reaction.

Pre-existing endometriosis in the tube would favour nidation but as tubal endometriosis is uncommon it is likely to be a causal factor in an occasional case.

Pre-existing decidual reaction in the mucosa of the tube is considered by some as a causal factor but usually decidual reaction in the tube occurs as a protective reaction against deep burrowing of the ovum after it has been implanted in the tube.

Terminations of Tubal Pregnancy

Except for a few cases of tubal gestation advancing to full term, the usual termination is rupture which may occur in one of the following directions: (1) intra-mural, (2) extra-tubal, and (3) intra-tubal.

Rupture in any of the three directions is precipitated by (a) the destructive action of the trophoblast, (b) the haemorrhage into the gestation sac caused from eroded maternal vessels, and (c) the absence of hypertrophy of the muscular layer with the growth of the ovum. As a result of stretching and thinning of muscular bundles forming the sac wall, further increase in tension from haemorrhage in and around the sac leads to rupture.

Intra-mural Rupture. The ectopic ovum burrows beneath the mucous membrane into the muscular layer and, as a result, the rupture is at first intra-mural and later becomes either external into the peritoneal cavity or into the broad ligament, or, internal into the lumen of the tube. Macroscopic appearances are sometimes deceptive, as an intra-mural rupture closely simulates an intra-tubal one. If the bleeding is small in quantity and anatomical relations are still preserved a probe can be passed to define the lumen and thus demonstrate the intra-mural rupture.

The effects of rupture in both, extra-tubal and intra-tubal rupture, depend on the severity of the bleeding from the site of the rupture. (a) When bleeding is severe, a large amount of blood collects in the general peritoneal cavity with clinical picture of sudden diffuse, intra-peritoneal haemorrhage. (b) When bleeding is small in quantity and occurs at intervals there is localized collection of blood either in the pouch of Douglas, or, in the broad ligament. (c) When the bleeding is very small in quantity, coagulation occurs at the site of the tiny rupture forming a *peritubal* or a *paratubal* haematocoele.

Extra-tubal Rupture. When extra-tubal rupture occurs, the ovum is expelled into the peritoneal cavity or into the broad ligament. In the majority of cases the ovum after rupture ceases to grow, but in an occasional case it continues to develop in the abdomen as secondary abdominal pregnancy (Plate 78).

Diffuse intra-peritoneal haemorrhage occurs when there is extensive injury to the tube with continuous bleeding from erosion of large blood vessels. Severe intra-peritoneal bleeding causes collapse which may end fatally if it is not promptly treated.

Pelvic Haematocoele. If the bleeding from the site of rupture not severe, the blood collects in the pouch of Douglas. The presence of blood in the pelvic cavity causes localized peritonitis with the surrounding structures forming a false sac. The sac is bounded in front by the uterus, behind by the rectum and the sigmoid colon which is generally pushed to the left, below by the

peritoneum of the floor of the pouch of Douglas, and above, forming its roof, are the coils of the small intestines and the omentum. The contents of a haematocele consist of dark viscid blood and blood clots. The embryo may be completely absorbed or it may be present among the blood clots (Fig. 54).

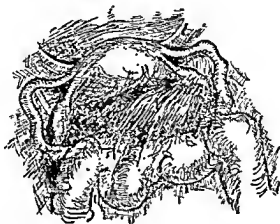


Fig. 54. Diagrammatic representation of pelvic haematocele as seen after opening the abdomen.

Para-tubal Haematocele. When a tiny rupture occurs following erosion by chorionic villi, blood coagulates around the site of rupture to form *paratubal haematocele*.

Intra-tubal Rupture. When the ovum surrounded by blood clots is expelled into the lumen of the tube, it is known as a *tubal mole*. A tubal mole is formed by repeated small haemorrhages in the 'chorio-decidual' space from the eroded blood vessels.

When a tubal mole is expelled from the fimbrial end of the tube it is called *tubal abortion*. It is more likely when the ovum is primarily embedded in the ampullary portion of the tube, because contractions of the tube can then readily expel the ovum into the peritoneum. In tubal abortion the entire capsule remains behind in the maternal tissues after the expulsion of the ovum. Bleeding continues from this raw area in the wall of the tube. Further terminations depend on the severity of bleeding from this area (Plate 79).

Intraperitoneal bleeding from tubal abortion can be as severe and is as common as in the case of extra-tubal rupture of the tube. When blood from the fimbrial end leaks out gradually and collects in the pouch of Douglas a pelvic haematocele is formed. If there is

slow leaking of blood, a clot forms around the fimbrial end to form a *peritubal haematocoele*. Many cases of peritubal haematocoele are really cases of embedding occurring at the fimbrial end.

Haematosalpinx. In some cases, a haematosalpinx forms as a result of internal rupture. It is difficult to prove whether the abdominal ostium was closed before or after the embedding of the ovum. In the former case, embedding is due to the internal migration of the ovum, while in the latter, the abdominal ostium is sealed by a blood clot which later organizes into fibrous tissue.

A pseudo-haematosalpinx is sometimes formed after intramural rupture. The collected blood is then not in the lumen of the tube but is in the muscular wall.

Interstitial Pregnancy. In this type the ovum embeds in an uterine diverticulum or in a cornual adenomyosis. Characteristic appearances in interstitial pregnancy are: (1) The antero-lateral attachment of the round ligament in relation to the sac. In isthmal pregnancy the round ligament is attached to the inner side of the sac, (2) the appendages are asymmetrically placed, (3) the fundus is tilted at times almost vertically (Ruge-Simon's sign), (4) the lateral insertion of the Fallopian tube, and (5) cornual swelling merging insensibly with the uterus by a broad base. The usual mode of termination is rupture into the peritoneal cavity (Plate 80).

Angular Pregnancy. When implantation of the ovum occurs in the utero-tubal angle of a normal uterus it produces asymmetrical enlargement of the uterus during the first three months of pregnancy. It is really an uterine pregnancy but is generally described under ectopic pregnancy because it is impossible to differentiate it from an interstitial pregnancy. It often gives rise to severe pain on one side of the abdomen. After the third month, the uterus becomes uniform in size and pregnancy continues normally.

Advanced Ectopic Pregnancy. Except for a few cases in which pregnancy continues in the tube without rupture, all other cases are of secondary abdominal pregnancy.

In secondary abdominal pregnancy, the fertilized ovum primarily embeds in the tube. After developing in the tube for some weeks, the tube ruptures and the embryo is expelled into the peritoneal cavity. Secondary abdominal implantation only occurs if part of the placenta remains attached to the tube. The villi begin to grow outwards from the site of rupture so that in course of time most of the placenta is formed outside the tube. Formerly,

it was believed that the embryo could continue its development only if it was extruded from the tube with its membranes intact, but this is not an essential requirement (Plate 81).

Secondary abdominal pregnancy also occurs when the ovum is primarily implanted at the fimbrial extremity. The chorionic villi grow outwards from the tube and eventually the entire placenta is formed outside the tube.

If the ovum continues to develop after rupture into the peritoneal cavity, 'secondary intra-peritoneal pregnancy' occurs. If it ruptures into the broad ligament, 'secondary intra-ligamentary pregnancy' occurs.

Secondary Intra-peritoneal Pregnancy. When the foetus escapes into the peritoneal cavity, either with its membranes intact or without them, a pseudo sac is formed by organized blood clots, coils of the intestines, the omentum and other abdominal structures.

Secondary Intra-ligamentary Pregnancy. It is an uncommon termination. Champion and Tessitore in 1939 reported 70 cases of intra-ligamentary pregnancy that had developed for over seven months. It is generally assumed that this variety results from rupture of a tubal pregnancy into the broad ligament. Champion and Tessitore suggest an alternative explanation that an intra-ligamentary pregnancy results from implantation of a primary abdominal or ovarian pregnancy on the posterior layer. As a result of growth, the posterior layer of the broad ligament becomes thinned out and ruptures, so that further growth occurs in the broad ligament. This is often indicated at operation when, after removal of the ovum, difficulty is experienced in peritonizing. The growing ovum accommodates itself by stripping the anterior or the posterior layer of the broad ligament upto a certain level. The placenta is usually attached to the liver, spleen or other posterior abdominal structures (Plate 82).

Histology. In tubal pregnancy, scattered villi are seen in the tubal lumen surrounded by haemorrhage. The tubal musculature is split by haemorrhage within it (Plate 83).

Changes in Uterine Mucosa. Soon after ectopic embedding of the ovum, decidual changes occur in the uterine endometrium. The decidua so formed remains intact as long as the embryo is alive and degenerative changes commence in it when the embryo dies. The decidua is then expelled either as a complete cast or it disintegrates in small particles.

Changes in Ectopic Ovum. Absorption. A tiny ovum may

undergo complete absorption in the tube or when it is discharged into the peritoneal cavity. In the absence of bleeding such retrogression may escape clinical attention. Retrogression is proved by the histological evidence of hyalinized villi in the tubes which otherwise appear normal.

Foetal Deformities. This has been observed in 10-15% of the reported cases of advanced pregnancy. The majority of deformities are skeletal and can be corrected by manipulative treatment. They are caused by pressure due to oligo-hydramnios or adhesions to the sac.

Hydatidiform Degeneration of Chorion and Formation of Chorionepithelioma. Mayer has shown by careful examination of specimen that villi in tubal gestation do undergo hydatidiform degeneration, and a few such cases have been reported.

Mummification. It occurs in a foetus which has been retained for many years without infecting the gestation sac. The liquor amnii is absorbed.

Suppuration. Infection of the foetal sac from the sigmoid colon or the small intestine is likely to occur soon after the death of the foetus or after a lapse of many years. When infection occurs, the soft parts are disintegrated and the infected contents are finally discharged through the anterior abdominal wall, usually at the umbilicus or through the rectum, the bladder or the posterior vaginal fornix. Nature seldom succeeds in evacuating all the contents, particularly the remnants of the foetal skeleton, and a fistula forms which closes only after all the contents are evacuated either naturally or by operation.

Calcification of Ovum. Partial or complete calcification of a dead foetus which has remained in the abdomen for a number of years is known as *lithopaedion*. Calcification may also occur in the membranes or the placenta with or without calcification of the foetus. Many cases of *lithopaedion* of long standing have been reported. Smith reported in 1912 a *lithopaedion* which had remained in the abdomen for sixty years and was found at post mortem in a woman aged 94. Speckman reported a case from Bombay, of a woman aged 75 in whom *lithopaedion* of 46 years' duration was present.

Ectopic Gestation and Multiple Pregnancy

Multiple ectopic gestation is grouped in the following manner:

- (1) Combined intra-uterine and extra-uterine pregnancy.

(2) Twin tubal pregnancy where one tube contains two embryos.

(3) Bilateral tubal pregnancy where each tube contains one embryo.

(4) Multiple tubal pregnancy.

Combined Intra-uterine and Extra-uterine Pregnancy. In 1926 Novak gave a comprehensive review of 276 cases from the literature. In 1940, Mitra reviewed 304 and added two more of his own. Since then several other cases have been reported in the literature. The majority of the reported cases have occurred in multiparous women. Generally, the extra-uterine gestation precedes the intrauterine, or both may occur at about the same time.

The clinical manifestations of extra-uterine gestation dominate over those of the intra-uterine pregnancy. The tubal gestation ruptures during the early months and diagnosis of combined pregnancy is arrived at in most of the cases only during operation for ectopic pregnancy. Very few cases have been on record in which both conceptions had reached to full term without interruption.

Twin Tubal Pregnancy. The two embryos may be contained in a single sac or in two separate sacs. Uniovular twins frequently occur in extra-uterine pregnancy.

Bilateral Tubal Pregnancy. It is necessary to distinguish between successive and simultaneous pregnancies; successive are the more frequent. A successive pregnancy is one in which pregnancy in one of the tubes is arrested in the early stages and may terminate as a haematosalpinx, a haematocele or a lithopaedion and, later, pregnancy in the other tube discloses the nature of the first.

Multiple Tubal Pregnancy. McCalla mentions a case reported by Treub of Amsterdam in which one tube contained five embryos. In 1914, triplets were reported by Daimant, and another case was reported by Krusen. A case is also reported by Launey and Seguinot in which there was twin pregnancy on one side and a single foetus on the opposite side.

Clinical Features ✓

Ectopic pregnancy is perhaps the most common of all the gynaecological conditions eluding and misleading diagnosis, and gynaecologists of experience have not been exempt. When an ectopic pregnancy terminates in one of the above mentioned ways,

clinical symptoms related to haemorrhage, plastic peritonitis, pressure on adjacent pelvic viscera or infection occur.

Symptoms. Amenorrhoea. Cessation of menstruation in a regularly menstruating woman so very characteristic of intra-uterine pregnancy occurs also in ectopic pregnancy but not in all cases, and should not be considered as an invariable symptom. Amenorrhoea of several weeks' duration is usual when embedding has occurred in the ampullary portion of the tube. It is frequently absent in interstitial and isthmic pregnancy, as usually rupture occurs within a few days after embedding.

Vaginal Bleeding. Vaginal bleeding occurs when the decidua begins to separate after the death of the ectopic ovum and it continues until the entire decidua has been cast off. When the whole decidua is shed as a cast sharp bleeding occurs for a day or two, but when the decidua desquamates piecemeal slight vaginal bleeding continues for a week or more.

Vaginal bleeding after a period of amenorrhoea is characteristic but not uncommonly it signifies itself as a prolonged menstrual period. In some cases of sudden rupture of an ectopic gestation vaginal bleeding occurs a day or two after the operation as a result of separation of the decidual cast.

Pain. Except in some cases where ectopic gestation is detected in its very early stages, it is extremely rare to meet with a case where pain is not complained of. Even when an ectopic gestation has not ruptured, there is continuous dull pain on one side due to distension of the tube.

When sudden extra-tubal rupture occurs the patient very often states that she felt as if something had burst inside her. The pain is severe from its commencement, may be localized for a few hours in the lower abdomen, but later becomes generalized.

During expulsion of a tubal mole or blood clots from the fimbrial end of the tube there is spasmodic pain. When a pelvic haematocoele forms, pain in the hypogastrium with backache in the lumbosacral region is usually present.

Sometimes, the patient who has been suffering from continuous lower abdominal pain complains of an unusually severe attack with symptoms of shock which signifies secondary rupture of the gestation sac.

Pressure Symptoms. Pressure symptoms usually occur with pelvic haematocoele. Difficulty in passing urine followed by retention is the commonest pressure symptom. In some cases rectal

tenesmus is a prominent symptom.

Pain in one or both shoulders sometimes occurs from pressure on the phrenic nerves by free blood collected in the peritoneal cavity.

Clinical Types and Differential Diagnosis

Clinically, four types can be distinguished, and the clinical features and differential diagnosis of each are discussed separately. The four types are:

- (1) Acute fulminating.
- (2) Sub-acute.
- (3) Pelvic haematocele.
- (4) Advanced gestation.

Acute Fulminating. There is an erroneous impression that this clinical type is the most frequent. In this condition a woman enjoying good health is suddenly taken ill with acute abdominal pain and she may state that something has burst inside her. The pain is localized at first to some part of the lower abdomen but within a few hours it is felt all over the abdomen. Sometimes, there is no history of amenorrhoea or vaginal bleeding, particularly in cases of rupture of an interstitial or isthmic tubal pregnancy. The general condition of the patient deteriorates very rapidly and the patient becomes markedly pale within a few hours. Pulse rate rises rapidly and the volume becomes correspondingly smaller with fall of blood pressure. Profuse sweating, thirst, cold and clammy skin with restlessness and 'air hunger' become more and more marked due to internal haemorrhage.

On abdominal examination, diffuse tenderness on palpation is present but usually there is no rigidity of muscles. Shifting dullness due to the presence of free blood in the peritoneal cavity is sometimes present but it is not a dependable sign.

A satisfactory bimanual vaginal examination is not possible due to abdominal and vaginal tenderness. In fact, the absence of tenderness during vaginal examination indicates some other condition than ruptured ectopic pregnancy. If rupture has occurred at an early stage no mass is felt in the fornices but a fluctuating indefinite cystic fullness is elicited in the pouch of Douglas due to the collection of blood. When an ovum, about ten weeks or more, ruptures an indefinite mass is frequently palpated in one of the lateral fornices.

Differential Diagnosis. *Rupture of Graafian Follicle or Corpus Luteum with Massive Intra-peritoneal Haemorrhage.* This condition is uncommon but closely simulates acute rupture of an ectopic gestation. With massive haemorrhage, sudden abdominal pain and other signs of internal bleeding appear. Vaginal examination is tender and elicits fullness in the pouch of Douglas due to the collection of blood.

Torsion of Pedicle of an Ovarian Cyst. The patient complains of sudden acute abdominal pain with signs of shock. Increasing pallor which is so very characteristic of ruptured ectopic is absent. If the torsion is sudden, vomiting is a prominent symptom. There is marked tenderness and rigidity in the lower abdomen, more on the side where the cyst is situated. On vaginal examination a well defined tender, tense mass is palpated in one of the fornices with the uterus pushed to the opposite side.

Acute Appendicitis. Pain in the right iliac fossa, tenderness in the McBurney's point and a tender right fornix on bimanual vaginal examination usually lead to a diagnosis of acute appendicitis but an acute attack during or soon after a threatened abortion is likely to cause difficulty because of the associated amenorrhoea and vaginal bleeding. In such a case absence of a mass in the right fornix with an enlarged soft uterus excludes the possibility of an ectopic gestation. Sometimes, early general peritonitis following a perforated appendix masks the diagnosis because the pain and tenderness, although more marked in the right iliac fossa, become generalized. High temperature, rapid pulse rate and increasing leucocytosis are important diagnostic features.

Acute Salpingitis. The sudden onset of severe abdominal pain, tenderness and other signs of shock simulate a ruptured ectopic pregnancy so closely that the clinician now and again realizes the mistake only on opening the abdomen. The onset of abdominal pain during a menstrual period or after a recent abortion indicates salpingitis. Rise of temperature, particularly with rigor, occurs with salpingitis while the temperature is normal or even subnormal with ruptured ectopic pregnancy. A few hours' observation usually decides the diagnosis because in ectopic pregnancy, with diffuse intraperitoneal bleeding, the pulse rate continues to rise, the blood pressure falls and pallor increases.

Other Abdominal Surgical Emergencies. (1) Perforation of a hollow viscus is differentiated by taking a careful history. (2) Acute haemorrhagic pancreatitis is a rare abdominal emergency

and, as internal haemorrhage occurs in this condition also, differentiation from acute rupture of an ectopic gestation is very difficult.

Sub-acute. This is the most common variety met with in practice. As a rule, there is a period of amenorrhoea followed by repeated attacks of abdominal pain, vaginal bleeding and faintness. This trio of symptoms is important in differentiating it from other conditions. There is a slight continuous pain in the lower abdomen punctuated by colicky attacks. The vaginal bleeding is usually slight but is more during the attacks of pain. The feeling of faintness is due to the sudden escape of blood in the peritoneal cavity.

On vaginal examination, the uterus is slightly larger than normal size, pushed to one side and is felt separate from the mass in one or the other lateral fornix. The mass is not entirely in one lateral fornix but is postero-lateral in situation and is of indefinite outline and of varying consistency, being soft in some parts and firm in others. This varying consistency is an important sign, being soft where the blood has accumulated recently and firm where organization of blood of some duration has occurred. Acute tenderness on palpation is also an important clinical sign. As a rule, the mass is partially or completely fixed.

Differential Diagnosis. Uterine Abortion. It is a serious mistake to diagnose uterine abortion when actually a tubal pregnancy exists. If curettage is undertaken without a careful vaginal examination disastrous result from rupture of the ectopic sac is likely to follow.

Uterine Pregnancy with Lateral Flexion of Uterus. A laterally flexed pregnant uterus of 8 to 10 weeks' size is likely to cause confusion. The important point to bear in mind is that whenever a mass is palpated in one of the fornices and the uterus cannot be felt separately from the mass, further observation and examination, if necessary under anaesthesia; must be done. It will then be possible to correct the laterally flexed gravid uterus into an anteverted position and the mass which was previously felt in the fornix is proved to be the gravid uterus.

Fibromyoma in Lateral Wall of Uterus with Early Abortion. In this condition there is pain and vaginal bleeding and a mass is palpated in one fornix. If chorionic villi are found on microscopic examination of tissue passed from the uterine cavity, the diagnosis of uterine pregnancy will be evident. The mistake is still more likely if red degeneration of fibromyoma has made it painful and tender on vaginal examination.

Pelvic Haematocoele. The clinical history is similar to that described for the sub-acute type. Patients frequently come under observation for pressure symptoms, like difficulty in passing urine, retention of urine and rectal tenesmus. Rectal tenesmus is sometimes mistaken for mucus colitis or dysentery and the patient is treated medically until either secondary rupture precipitates an emergency or gynaecological examination is carried out when medical measures fail to relieve the rectal symptoms.

On abdominal examination a tender, indefinite swelling arising from the pelvis is palpated. As the collection of blood increases, the swelling also increases in size and may rise up to the umbilicus or to even a higher level. The consistency of the swelling varies and may be elastic or firm, depending on the duration and the extent of bleeding and the structures forming the sac.

On vaginal examination the cervix is felt with difficulty as it is pushed bodily forward behind the symphysis pubis by the collection of blood in the pouch of Douglas. The dome of the vagina and the fornices appear shallow. The upper third of the posterior vaginal wall is raised by collection of blood in the pouch of Douglas and its surface is convex towards the vagina. The uterus is felt to be 'riding' on top of the swelling and may be in the midline or to one side. The mass is felt to be tender, of indefinite outline, of cystic consistency in some part and firm in other parts. This varying consistency of the mass is an important clinical sign. The extent of haematocoele is better defined by rectal examination.

Differential Diagnosis. *Incarcerated Retroverted Gravid Uterus.* It is generally mistaken for an ectopic pregnancy in the third month of gestation when incarceration of the uterus is likely to occur. Dysuria and later retention of urine occur. In both, the cervix is pushed behind the symphysis pubis but in the case of retroverted gravid uterus it is directed well forward also. In retrogravid uterus, the fundus or any part of the uterus is not felt separate from the mass in the pouch of Douglas, while in pelvic haematocoele a small portion of the uterus or the whole of it can be palpated on the top of the mass. A retrogravid uterus is uniformly firm, while a pelvic haematocoele is of irregular consistency.

Pelvic Abscess. On examination the physical findings are similar to those of pelvic haematocoele and careful evaluation of the history is necessary to differentiate the two conditions. In pelvic abscess there is a history of recent post abortal or gonococ-

cal infection. There is intermittent rise of temperature and marked leucocytosis. Aspiration of the contents by passing a lumbar puncture needle through the posterior fornix diagnoses an ectopic if dark, tarry blood is withdrawn and pelvic abscess when pus is aspirated.

Incarcerated Ovarian Cyst with Uterine Pregnancy. Abdominal pain, vaginal bleeding and a mass in the pouch of Douglas cause confusion, but the absence of amenorrhoea and the uniform consistency of the cyst are differentiating features. On aspirating the contents of the pouch of Douglas, serous or mucoid fluid is found.

Fibromyoma in Posterior Wall with Uterine Pregnancy. Retention of urine is a common symptom. On vaginal examination the cervix is pointing downwards and pushed up behind the pubis. The mass in the pouch of Douglas will be hard, rounded and in close apposition with the cervix.

Advanced Ectopic Pregnancy. History of amenorrhoea interrupted by slight vaginal bleeding and abdominal pain in the early months is suggestive; breast changes also continue as in intra-uterine conception. Abdominal pain, continuous or at intervals, is generally present and is due to plastic peritonitis or is due to the altered anatomical relations of the abdominal viscera. Vigorous foetal movement are felt by the patient and continue till the death of the foetus. At or near full term intermittent pains, 'false' labour, occur for a short time with vaginal bleeding and passage of a decidual cast. Foetal movement cease soon after 'false' labour.

After the death of the foetus there may not be any further symptoms. Amenorrhoea may continue or menstruation reappears and such cases come under observation for an abdominal tumour after a period of months or years.

On abdominal examination the foetal parts are very easily palpated. Not infrequently, foetal parts are felt with great ease even in uterine pregnancy when the uterine and the abdominal walls are lax and undue reliance on this sign is not advocated. On the other hand, the contour of the abdominal swelling is a more reliable sign as it is ill defined in abdominal pregnancy in contrast to the well defined swelling of an intra-uterine pregnancy. The foetus is usually high above the pelvic brim and transverse or oblique lie is frequent. Eccentric position of the foetus to one side is also a useful diagnostic sign.

The pitocin test to elicit uterine contractions is sometimes

useful. Half unit of pitocin is injected and the abdomen is palpated for uterine contractions and, if contractions do not occur in 15 minutes, one more unit is given. A positive test rules out an abdominal pregnancy but a negative test is inconclusive.

On vaginal examination the cervix is found to be firm. In intra-uterine pregnancy the vaginal portion of the cervix is soft and almost taken up after the sixth month, but in abdominal pregnancy a definite firm vaginal cervix is palpated and is an important distinguishing sign. The presenting part is not within reach of the vaginal fingers. On careful palpation the uterus is found to be normal or slightly enlarged and displaced laterally and forwards.

Radiological Signs: (1) Finding the foetal parts behind or in close proximity to the spine in a lateral film (Sherwin's Sign). (2) The foetus high above the pubis, eccentric in situation or in a transverse lie. (3) Gas shadows in an antero posterior film.

During 'false' labour, uterine contractions are not felt per abdomen. There is vaginal bleeding which may be mistaken for 'show'.

After the death of the foetus the gestation sac becomes smaller and in the absence of infection it may remain undiagnosed for many years. The foetus in course of time is converted into a lithopœdion. Menstruation continues as usual and one or more uterine pregnancies may occur with the sac in the abdomen. If the sac gets infected it discharges its contents by forming an abdominal sinus or a fistulous tract may form with the vagina, the bladder or the rectum.

Treatment of Tubal Pregnancy

Acute Fulminating Type. The general condition of the patient is unsatisfactory; some are in such a collapsed state that they are pulseless and their blood pressure cannot be recorded while others have a fast pulse with a low blood pressure. The collapse is partly due to shock following effusion of blood in the peritoneal cavity but more so on account of blood loss. No sooner the diagnosis is made an injection of morphia, $\frac{1}{2}$ gr., is given. Hot water bottles are carefully placed to keep the patient warm and in those who are in a completely collapsed state blood transfusion is started while waiting for the operation theatre to be ready.

It is needless to state that spinal anaesthesia is contra-indicated in acute fulminating cases where the blood pressure is very low.

Local infiltration of the abdominal walls, or nitrous oxide, or cyclopropane gas anaesthesia is preferable. Epidural spinal anaesthesia can also be used in collapsed cases as it does not lower the blood pressure.

The abdomen is opened by a midline subumbilical incision. When the peritoneum is reached, a bluish discolouration will be observed through it. The peritoneum is held by forceps and a small opening is made. The free blood in the peritoneal cavity is collected for auto-transfusion. The appendages are brought out and examined. The affected tube is removed by clamping the mesosalpinx. In almost all cases the ovary is left behind. The appendages of the other side are examined before closing the abdomen.

When an interstitial tubal pregnancy has ruptured, it is necessary to remove a wedge of the uterine cornu including the sac. At times, in a multiparous patient a subtotal hysterectomy is performed.

Sub-acute Type. As the general condition of the patient is satisfactory, local, spinal or general anaesthesia can be given. After opening the abdomen, the affected tube is excised.

Pelvic Haematocele. In this type, when the abdomen is opened, matted intestines and omentum will be found shutting off the pelvic contents. The omentum and intestines forming the roof are separated when large quantities of blood clots will be visible. Only after clearing away the blood clots will it be possible to locate the uterus and the appendages. Salpingectomy of the affected tube is then performed.

If a pelvic haematocele is infected it is better drained through the posterior fornix as the peritoneal cavity is likely to be infected by the abdominal route.

Secondary Abdominal Pregnancy. Formerly, the surgical treatment of secondary abdominal pregnancy was formidable. The maternal mortality due to severe shock and haemorrhage as a result of attempts to separate the placenta from its attachments to abdominal organs was high. Cornell and Lash in 1933 reviewed 236 cases of abdominal pregnancy and found that the high mortality was due to shock and haemorrhage resulting from attempts to remove the adherent placenta. To circumvent this difficulty many preferred to wait, even when diagnosis had been made while the foetus was alive and viable, until several weeks after the death of the foetus so that placental circulation would cease and thus

the risk of bleeding during or after separation of the placenta was diminished. Since the last few years the hazards of shock and haemorrhage following operation for secondary abdominal pregnancy have been eliminated by leaving the placenta intact in the abdominal cavity after removing the foetus. Laparotomy should be performed as soon as the diagnosis is made, but in exceptional cases, when the foetus is premature, the operation may be deferred to obtain a mature child. The patient should, however, be hospitalized during the period of waiting. A plain X-ray of the abdomen must be taken to exclude gross congenital malformations. If the foetus is malformed, immediate laparotomy is performed. It is difficult to calculate the duration of pregnancy because, during early months, pain and bleeding frequently mislead the calculation. The chief disadvantage of waiting for maturity of the foetus is that the foetal heart may disappear during the waiting period.

The umbilical cord is tied close to its attachment to the placenta and the abdomen is closed without drainage. In course of time the placenta gets absorbed without any complications. In an occasional case the placenta gets infected and then a second operation is necessary to drain the pus and remove the placenta. Mason reviewed 60 cases of secondary abdominal pregnancy and there was no death in those cases in which an attempt was not made to remove the placenta. In some cases the major part of the placenta is situated in the Fallopian tube and it is then an easy matter to remove the placenta by excising the tube.

Ovarian Pregnancy

Primary ovarian pregnancy is rare. In 1952, Baden and Heins reviewed the literature and found only 90 cases which adequately fulfilled the criteria of ovarian pregnancy.

There are divergent views regarding the causation of ovarian pregnancy. Implantation may occur in the ruptured Graafian follicle or on the surface of the ovary.

In intra-follicular implantation, fertilization occurs within a ruptured follicle from which the ovum has failed to dislodge itself. Normally, two factors help to expel the ovum from the ruptured follicle, one being intra-follicular pressure and the other the resistance of tunica albuginea. If the tunica albuginea is thickened, rupture is only a slight tear and the fluid trickles away

without dislodging the ovum. This view is not accepted at present as it is known that the presence of a corpus luteum is essential for the embedding of the ovum (Plate 84).

Meyer has shown that endometrial tissue is frequently found on the surface of the ovary, probably a metaplastic change from the germinal epithelium and implantation of the fertilized ovum is much more likely to occur on such favourable tissue.

Spiegelberg in 1887 stated that the following conditions must be satisfied before a case can be diagnosed as a true ovarian pregnancy: (1) The Fallopian tube on the side of the pregnancy must be intact. (2) The foetal sac must occupy the position of the ovary. (3) The ovary must be connected with the uterus by the utero-ovarian ligament. (4) Definite ovarian tissue must be found in the wall of the sac.

Williams and Jacobson added the following conditions to those stated above: (1) The Fallopian tube must not only be intact but must be free from any evidence of gestation, (2) definite ovarian tissue must be found in the wall of the sac in several places, (3) the embryo must be visible in the cavity of the sac, (4) there must be placental tissue with the ovarian stroma.

Terminations of Ovarian Pregnancy. The most common termination of ovarian pregnancy is early rupture with diffuse intra-peritoneal bleeding. This is particularly likely to occur when embedding has occurred on the surface of the ovary. Several cases of ovarian pregnancy that have gone to full term have been reported.

Clinical Features. When a case comes under observation after rupture with intra-peritoneal bleeding it is diagnosed as a case of ectopic pregnancy and the true nature is recognized only after opening the abdomen. In other words, there is no clinical difference between an ectopic tubal and ectopic ovarian pregnancy.

Before rupture, an ovarian pregnancy is generally diagnosed as an ovarian cyst and its true nature is recognized during operation in some cases and in others from the pathological report.

Pregnancy in Rudimentary Horn of a Bicornuate Uterus

Mode of Fertilization. The absence of any communication between the cavity of a rudimentary horn and the cervix of the other normally developed horn indicates *external migration* of the spermatozoa or of the fertilized ovum as the only possible mode

of fertilization. Chalmers, Latto and Norman are of the opinion that the part of the rudimentary horn attached to the other developed horn is canalized. They have produced hysterosalpingographic and operative evidence to support their view.

Clinical Course. The usual termination is rupture of the horn. The duration of gestation before rupture depends upon the degree of development of the rudimentary horn. In some cases, when the horn is very small and poorly developed, rupture occurs in the early weeks, but usually there is sufficient development to allow the pregnancy to continue till 16-20 weeks before rupture. Cases have been recorded where pregnancy has continued till full term. In one case at the K.E.M. Hospital, a dead foetus was extracted after 16 months of amenorrhoea. Cases of torsion of the pedicle of the rudimentary horn with clinical features suggestive of a twisted ovarian cyst have been recorded.

Clinical Features. As long as pregnancy progresses normally there are no symptoms and the condition remains undetected. In early weeks it is frequently wrongly diagnosed as an ovarian cyst or fibromyoma because the normally developed horn is considered to be the non-pregnant uterus and the firm globular pregnant rudimentary horn as a fibromyoma or an ovarian cyst. With history of amenorrhoea and the above findings, an X-ray, preferably with lipiodol injection, is helpful in diagnosis. Malformations of the vagina as partial septum may also assist in directing attention to this condition. When rupture occurs the clinical picture is like that of the 'fulminating' type of ectopic gestation (Plates 85, 86).

Treatment. The gravid horn is removed by clamping the ovarian ligament, the Fallopian tube, the round ligament and the fibrous band with which it is attached to the normally developed horn.

Cervical Pregnancy

Cervical implantation of the ovum is a rare type of ectopic pregnancy. Mehta reported a case from Bombay in 1956. Studiford, in 1945, collected 48 cases, and Schneider and Dreizin, in 1957, reviewed 60 cases from the world literature. They divided the cases into three types: (1) true cervical pregnancy, (2) isthmico cervical pregnancy, and (3) endometrial isthmico cervical pregnancy.

In true cervical pregnancy, there is practically no decidua and each case is essentially one of placenta accreta. A true cervical pregnancy never progresses beyond the twelfth week of gestation. Profuse bleeding occurs from partial separation (Plate 87).

In isthmico cervical pregnancy, the placenta tends to separate more easily with less haemorrhage because the decidual reaction diminishes from above downwards.

In endometrial-isthmico cervical pregnancy, only a small area is attached to the cervix. In the presence of good decidual reaction, separation of the ovum is easy without much bleeding.

Clinical diagnosis of cervical pregnancy is based on the enlargement and expansion of the cervix with the small body of the uterus perched on top of the cervix. A pathological diagnosis of cervical pregnancy is obtained only in those cases where hysterectomy is performed. A naked eye and histological examination of the uterus reveal the absence of foetal elements in the body of the uterus, and that a part or whole of the placenta is situated below the reflection of the utero-vesical peritoneum.

Spontaneous or digital evacuation of the ovum is accompanied by severe, and frequently uncontrollable haemorrhage. Large quantities of blood should always be ready to overcome this complication, and, in recent years, ready availability of blood has reduced the need for total hysterectomy.

Prognosis

The prognosis depends on the general condition of the patient. In cases of tubal abortion or extra-tubal rupture there are signs of variable degree of shock due to intra-peritoneal haemorrhage and prognosis depends on the facilities available for immediate operation and on restorative measures for rallying the patient from shock. Collapsed patients who appear almost on the verge of death rally when plasma, a plasma substitute as well as blood are readily available. When intra-peritoneal bleeding is checked and the blood lost has been replaced the condition of the patient improves remarkably within a few hours. Under such favourable circumstances the mortality is very low but in their absence death occurs within 24-28 hours.

In the sub-acute type and when a pelvic haematocoele is suspected the general condition of the patient is, as a rule, good and it is safe to keep the patient under observation in a hospital and

carry out the various diagnostic tests. Operation is performed after proper pre-operative preparation and mortality is not greater than after other straightforward gynaecological operations.

Gravity of the operation for a secondary abdominal pregnancy has been almost completely eliminated by leaving the placenta intact in the abdominal cavity. The mortality following this procedure is negligible and in Mason's series quoted above it was nil.

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CHAPTER 5

NAUSEA AND VOMITING OF PREGNANCY (MORNING SICKNESS)

In the majority of women, nausea occurs during the first three months, but vomiting is less frequent. As vomiting often occurs in the morning, the lay expression is 'morning sickness'; but vomiting can occur at any time. It commences at about the fifth week of amenorrhoea, and worsens upto about the tenth week. Thereafter it gets less, and by the fourteenth week the patient is free from it. It is usually independent of the taking of food, but in severe form vomiting occurs after each meal, and if this is allowed to continue, it may pass into the severe form known as hyperemesis gravidarum.

Etiology. Many theories have been put forward to explain the vomiting of early pregnancy, but they are based more on mere suggestions than facts.

(1) *Psychological.* There can be no doubt that neurotic factor does play a role in the causation of vomiting of pregnancy in some cases, but certainly, it cannot be regarded as the cause in all of them. It occurs more frequently and more intensely in socially better placed women than in the poor hospital class of women. It is true that the fear of going through pregnancy and labour, or an unwanted pregnancy are important factors in the causation of severe vomiting. The fact that often during lactation amenorrhoea, women are first made aware of the presence of a fresh pregnancy by the development of morning sickness, indicates that neurosis is not a factor in every case.

(2) *Metabolic Disturbances.* It is considered to be due to faulty carbohydrate metabolism. The glycogen reserve of the maternal liver is said to be depleted to some extent by the abnormal demands of the ovum for its nutrition in the early weeks. It is unlikely that the glycogen demands of the tiny ovum could be so heavy as to upset the maternal glycogen reserve. The successful treatment of morning sickness by glucose administration, however, indicates that faulty carbohydrate metabolism plays an important role in its causation. As a result of the upset of carbohydrate metabolism, incomplete oxidation of fatty acids

occurs, and morning sickness may be looked upon as a mild acidosis.

(3) **Endocrine Disturbances.** Many biochemical investigations have been carried out to correlate the vomiting with endocrine changes, but there is no conclusive evidence in favour of any one of them. *Chorionic gonadotrophins*, which reach a peak at about 60 days after nidation, have received considerable attention. Kemp has put forward the view that, normally, adrenal cortical secretion detoxicates the gonadotrophins produced during pregnancy, and the high concentration of chorionic gonadotrophins found in severe vomiting is due to adrenal cortical insufficiency. It has been suggested that there is some relationship between increased production of progesterone and vomiting, but there is no definite evidence to support the relationship.

Treatment of Morning Sickness. The majority of mild cases of vomiting are brought under control by simple measures, and by reassurance.

The bowels are regulated by mild aperients, as constipation tends to aggravate the nausea and vomiting.

Large quantities of food are not tolerated by the stomach, and most of the semi-digested contents are vomited within a short time after taking food; therefore the patient is advised to spread out her meals by taking small quantities at intervals. Insufficient intake of liquids aggravates vomiting, and the patient is encouraged to take a couple of ounces of water sweetened with glucose every half hour. Juice of 6 to 8 sweet limes should be taken during the day.

As the vomiting is due to depletion of glycogen reserves, the patient should be advised to take as much rest as possible, so that glycogen is conserved.

Those who are not controlled by these simple measures are given 100-150 c.c. of 25% glucose, with 100 mg. of vitamin B₆, and 500 mg. of vitamin C intravenously, once or twice a day for a week, and it gives them considerable relief. Those who have a nervous background should be given tranquilisers for some days.

Hyperemesis Gravidarum

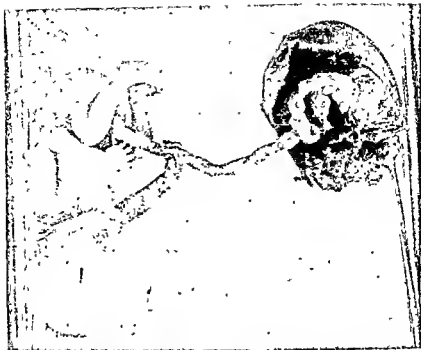
In most text-books, hyperemesis gravidarum is given a very important place among the diseases of pregnancy, giving an impression that it occurs fairly frequently; but in practice it is a rare



Pl-84. Cut section of ovarian pregnancy showing foetal sac. (Courtesy: G. S. M. College Museum, Bombay). (p 219)



Pl-85 Pregnancy in rudimentary horn of a bicornuate uterus. Below: A deciduous cast expelled from the normally developed horn. (Courtesy: N. W. M. Hospital Museum, Bombay). (p. 220).



Pl-86 Pregnancy in rudimentary horn of a bicornuate uterus (Courtesy: N W. M Hospital Museum, Bombay) (p 220)



Pl-87. Specimen of cervical pregnancy (Courtesy: Dr Louis Reswick, S. A. Med. Jour.) (p 221)

complication of pregnancy. It is usually included in the chapter on toxæmia of pregnancy but it is not a manifestation of toxæmia of pregnancy.

Hyperemesis originates as physiological morning sickness, but instead of subsiding with the advance of pregnancy it becomes worse, and if not treated properly, ends in death due to hepatic failure.

Causative Factors. The theories discussed for morning sickness also apply to this condition, but psychological factors often play a prominent role. Weiss and English suggest that the patient has some subconscious reasons to decide the termination of pregnancy, and to avoid its consequences. Its incidence is much higher among the upper class of women than among women of low income group.

Severe vomiting is frequently associated with the formation of hydatidiform mole, and it immediately subsides after evacuation of the mole. Vomiting is also severe in cases of multiple pregnancy.

Clinical Course. It commences as morning sickness of early pregnancy, and frequently this vomiting is regarded as an inevitable event of pregnancy by the patient or her medical attendant, in the hope that it will subside at the end of the third month. Instead, it persists and becomes progressively worse. It is, therefore, essential that every case of vomiting should be properly treated, as hyperemesis is the result of neglect. The vomiting occurs throughout the day apart from taking food, and a clinical picture of prolonged malnutrition develops.

Dehydration and emaciation occur, and the patient may lose as much as 10-15 kilograms in weight. The urinary output falls, and the blood urea tends to rise. A vicious circle is established in which starvation leads to ketosis, and the ketosis aggravates vomiting. Incessant vomiting may cause minute gastric hæmorrhages, as a result of which coffee ground vomitus occurs. The tongue becomes dry and sores may appear on the lips. The pulse rate rises and the blood pressure falls, both signs of grave prognosis. The temperature may also be elevated.

In some cases, neurological symptoms identical with Wernick's encephalopathy develop. The woman gets drowsy or loquacious. Nystagmus, diplopia, or retinal hæmorrhages may occur; medullary symptoms, such as nasal regurgitation on swallowing, occur in some cases. These are serious symptoms, and frequently, coma

and death follow. At autopsy, punctate haemorrhages have been detected in the midbrain.

Jaundice with the appearance of bilirubin and urobilin in the urine, indicate hepatic failure.

Treatment. A case of hyperemesis must be hospitalized, as constant supervision is essential. Besides, neurosis is an important factor, and isolation from oversolicitous relatives and friends is desirable. After the patient has got accustomed to hospital environment, gentle enquiries regarding her emotional difficulties should be made. Firm yet sympathetic approach is useful in controlling the distressing vomiting.

Tranquillisers are helpful in controlling persistent vomiting, and should be given freely. For the first few days, it is futile to give nourishments and fluids by mouth, the fluid loss being replaced by giving 1,500 c.c. of 5% dextrose solution with vitamin B complex and vitamin C as an intravenous drip, to replenish the depleted glycogen stores of the liver. To replace the loss of chlorides in the vomitus, 500 c.c. of N-saline in drip form is given. The urine is examined every day for the output, presence of acetone, chlorides and bile. The quantity of intra-venous fluids is controlled according to the urinary findings.

When vomiting has been controlled, feeding by mouth is gradually commenced. The diet should be rich in proteins and carbohydrates, as both are essential for protecting the liver.

Termination of Pregnancy. Most of the cases respond to this line of treatment but, in a few, termination of pregnancy is required. Termination of pregnancy is beneficial if it is done before neurological syndrome and hepatic failures develop. Termination is considered when (1) severe vomiting continues unabated for several days after admission, (2) the pulse rate rises progressively with fall in blood pressure, (3) the output of urine is scanty, the blood urea rises, (4) neurological symptoms are evident and (5) jaundice appears.

Termination by abdominal hysterotomy is carried out as by this time the pregnancy has advanced beyond 14-16 weeks. It is best performed under local infiltration anaesthesia, as hypotension contra-indicates spinal anaesthesia, and inhalation anaesthesia is not desirable in the presence of deranged hepatic function.

CHAPTER 6

TOXAEMIAS OF PREGNANCY

Introduction

Toxaemia of pregnancy is a grave disorder peculiar to gravid and puerperal women and unknown in the non-pregnant. It is also not known to occur in any species other than human. It is one of the most important complications of pregnancy, not only because it is very common but also because of the heavy maternal and foetal losses it entails. It is characterised by hypertension, oedema and proteinuria. When these symptoms of pre-eclampsia are neglected, eclampsia may supervene with convulsions and coma. Although the term eclampsia is in use for over 300 years, the concept of pre-eclampsia has evolved gradually only during this century.

Incidence. The incidence of toxæmia of pregnancy depends upon the prevalence of the various predisposing factors. It is also known to vary geographically, racially and with the socio-economic conditions. The incidence is high in backward countries with malnutrition, hypoproteinaemia and poor obstetric facilities. Since the disease is mostly preventable, availability of proper antenatal care is the most important single factor influencing its incidence. Hamlin of Sydney has shown that by proper antenatal care, the incidence of pre-eclampsia declined from 1:10 pregnancies to 1:55.5 and that of eclampsia from 1:350 pregnancies to 1:7000. In U.S.A., the incidence of pre-eclampsia and eclampsia is 6 and 0.05 per cent respectively.

Classification

Even in the seventeenth century, it was realised that convulsions occurring during pregnancy and puerperium could be divided into two groups: those which were not restricted to childbearing and those which were. The latter proved frequently fatal and were believed to be due to blood poisoning or toxæmia as a result of pregnancy.

Some years back, the term toxæmia of pregnancy included

many conditions related to each other neither by their pathological lesions nor by their clinical features. Some even sought to include in the group conditions like pyalism, chorea, gingivitis, neuritis, etc., by calling them *minor toxæmias of pregnancy*. Most of these conditions, as a result of increased knowledge regarding etiology and pathology, soon came to be dissociated from the toxæmias of pregnancy.

The American Committee of Maternal Welfare, in 1952, adopted the following classification of toxæmias of pregnancy.

- I. *Acute toxæmia of pregnancy.* (This is often referred to as specific toxæmia of pregnancy, perhaps a better term).
 - A. Pre-eclampsia:
 1. Mild.
 2. Severe.
 - B. Eclampsia.
- II. *Chronic hypertensive (vascular) disease with pregnancy.*
 - A. Without superimposed acute toxæmia:
 1. Hypertension known to have antedated pregnancy.
 2. Hypertension discovered during pregnancy (before 24th week).
 - B. With superimposed acute toxæmia.
- III. *Unclassified toxæmia (inability to differentiate the diagnosis for want of adequate data).*

Renal diseases associated with pregnancy, traditionally included in the group of toxæmias of pregnancy, are no longer considered so by many authors, and, rightly too, since they have an inflammatory or metabolic etiology and can be differentiated from pre-eclampsia.

Chronic hypertensive vascular disease occurs in nonpregnant women and in men also. Besides, a great majority of the women with chronic hypertensive vascular disease pass through pregnancy without the superimposition of acute toxæmia. Therefore, we feel that Group II A should not be included in the above classification.

CHAPTER 7

PRE-ECLAMPSIA

Etiology of Toxaemia of Pregnancy. This is discussed under eclampsia.

Clinical Features

The basic features of pre-eclampsia are an abnormal retention of water and sodium, and a wide spread arteriolar spasm. These are manifested as hypertension, oedema and proteinuria.

In majority of cases, the toxæmia is of a mild degree and is easily controlled by proper treatment. In some, the toxæmia becomes more severe and does not respond to medical measures until therapeutic termination of pregnancy ends the progress of the disease. Spontaneous premature labour occurs in many cases of toxæmia. Only in a few cases, the disease progressively advances to the convulsive stage of eclampsia. By efficient and prompt treatment of pre-eclampsia, it should almost always be possible to prevent the development of eclampsia. Except in a molar pregnancy, the disease rarely, if ever, sets in before the 24th week of gestation. Thereafter, the incidence of toxæmia of pregnancy rises with the duration of pregnancy.

Hypertension. Suddenly developing hypertension is the earliest sign of pre-eclampsia. A systolic blood pressure of 140 mm. or a diastolic pressure of 90 mm. is usually taken as the borderline between normal and toxæmic levels. However, absolute figures are of lesser significance than the relationship they bear to the basic blood pressure of the patient. A rise of 30 mm. or more in the systolic pressure and of 15 mm. or more in the diastolic pressure is a far better criterion of hypertension than absolute figures. In a patient without prior hypertension, blood pressure values, before the 24th week of pregnancy, should be taken as basal figures. The average blood pressure in non-pregnant Indian women is a systolic pressure of about 100 mm. and a diastolic pressure of about 70 mm. A systolic pressure of even 90 mm. is by no means rare. Therefore, a systolic pressure of 130 mm. and a diastolic pressure of 85 mm. should be taken as an early warning

sign of pre-eclampsia. Since a single blood pressure record is often misleading, the blood pressure reading must be confirmed by a repeated reading 6-12 hours later.

Oedema. As a warning sign, oedema is no less important than hypertension. In fact, occult oedema, as manifested by weight gain, often precedes hypertension. During pregnancy, weight increments of 1 pound per week or 5 pounds per month are the limits of normality. In Indian women, due to prevalent malnutrition and hypoproteinaemia, oedema of the ankles is very common during later months of pregnancy. It is frequently neglected by the patients and even by the medical practitioners until clinical features of toxæmia set in. Oedema during pregnancy should always be properly investigated and promptly treated.

Proteinuria. Unlike hypertension and oedema, proteinuria is not an early sign of toxæmia, usually manifesting some time after hypertension or oedema. It results from the increased permeability of the glomerular capillaries damaged by the hypertonicity of the afferent arterioles. The amount of proteins leaking in the urine fluctuates greatly even in the same patient, morning samples of urine usually containing lesser quantities.

In mild cases of pre-eclampsia, the oedema is restricted to the ankles. The systolic blood pressure is 140 mm. or below and the diastolic 95 mm. or below. Proteinuria is low, usually not exceeding 0.5 to 1 gm. per litre. On boiling the urine, it may just become turbid or only the topmost layer may become solid.

In moderate pre-eclampsia, the systolic pressure is between 140 and 160 mm. and the diastolic between 95 and 110 mm. There is extensive oedema of the lower limbs. Oedema of the fingers, face and abdominal walls may also occur in some cases. Proteinuria is moderate.

In severe pre-eclampsia, the systolic blood pressure is 160 mm. or above and the diastolic 110 mm. or above. Such high levels of blood pressure are of grave prognosis, both to the mother and to the foetus. The oedema is massive, vulval oedema and puffiness of the eyelids being often present. Oliguria and marked proteinuria are constant features of severe toxæmia and indicate marked renal damage. Proteinuria is usually more than 5 gm. per 24 hours, the urine turning solid on boiling. Headache, oliguria, visual disturbances and epigastric pain are commonly associated with severe toxæmia and are of grave prognosis. Any of these symptoms, even when present singly, indicates severe pre-eclampsia.

sia. Headache is usually frontal, though it may be occipital, and does not respond to symptomatic treatment. Slight blurring of the vision is reflected in the inability to read. Visual disturbances may progress to any degree; even temporary blindness may occur. These are due to the pathological changes in the retina, though some think them to be of central origin. Epigastric pain is due to the stretching of the liver capsule by haemorrhages and often immediately precedes convulsions.

Fulminating Pre-eclampsia. In majority of cases, the onset of pre-eclampsia is gradual and the disease progresses slowly. However, in a few cases, the onset is sudden and the disease rapidly progresses and approaches eclampsia in a matter of few days. These cases are often termed fulminating pre-eclampsia.

Imminent Eclampsia is a term used to describe those extremely severe cases of pre-eclampsia which are threatening to turn into eclampsia at any hour.

Retinal Changes in Pre-eclampsia

The commonest ophthalmoscopic finding in pre-eclampsia is an arteriolar spasm. Spasm or constriction of the retinal arterioles may be localised to a single point or to multiple sites, or it may be generalised. In the latter event, the normal 3:2 ratio of the diameter of the vein to that of the arteriole may be changed to 2:1 and, in severe cases, even to 3:1. Localised constrictions usually affect the proximal half of the arterioles which is nearer to the optic discs. Nasal branches are more often affected. Severe spasm of the arterioles, resulting in retinal ischaemia and oedema, may lead to visual disturbances. Retinal oedema may rarely progress to detachment of the retina. Fortunately, such retinal detachments carry good prognosis, full recovery of vision within a few weeks of delivery being the rule. Retinal haemorrhages and exudates are very rare in pre-eclampsia.

Diagnosis and Differential Diagnosis

When hypertension, oedema, occult or manifest, and proteinuria appear in the latter part of pregnancy in a woman who was known to be normal prior to the 24th week, the diagnosis of pre-eclampsia is self evident. However, if the patient with these manifestations is seen for the first time in the last trimester of preg-

nancy, the differentiation from essential hypertension often becomes impossible until a few months after delivery by which time a pre-eclamptic patient returns to complete normalcy. Generally speaking, a systolic pressure of 200 or above, diastolic pressure of 120 or above, retinal haemorrhages and exudates, and cardiac enlargement suggest essential hypertension rather than pre-eclampsia.

In over one-third of hypertensive women, the blood pressure level drops to some extent during the second trimester of pregnancy. Should the initial blood pressure be not very high, the systolic and diastolic readings may even be normal during the second trimester. In these women, the blood pressure tends to rise in the third trimester, and this rise is likely to be misdiagnosed as due to pre-eclamptic toxæmia unless the patient is known to be previously hypertensive.

Differentiation from chronic nephritis is also equally difficult, if a pre-eclamptic is seen for the first time in the last trimester of pregnancy. History of acute nephritis before pregnancy, if available, is a useful aid in the differentiation. Presence of red blood cells and casts in the urine and renal damage as evidenced by kidney function tests is suggestive of chronic nephritis.

Pathology of Pre-eclampsia

Death due to pre-eclampsia is a rarity. Hence post-mortem studies of the various organs for changes caused by pre-eclampsia are infrequent. However, on the basis of available data, it can be assumed that pathological changes in the different organs due to pre-eclampsia are similar to those seen in eclamptics, though of a lesser degree. Pathology of eclampsia is discussed under eclampsia.

Prognosis

Immediate. If eclampsia is prevented, the immediate prognosis for the mother is good. Untreated cases take a variable course. The most unfavourable cases progress to severe pre-eclampsia and may even develop eclamptic convulsions. The more favourable cases often remain stationary even when untreated. In any case, pre-eclampsia usually ends in premature labour.

Foetal prognosis depends upon the severity and duration of the disease. Persistence of systolic pressure beyond 160 mm. and

diastolic pressure beyond 100 mm. is dangerous for the foetus which may die in utero as a result of placental infarcts and anoxia. Prematurity also poses great danger to the foetus. Apart from spontaneous premature delivery, induction of premature labour might be necessary for uncontrolled cases.

Remote. Chronic glomerular nephritis, once thought to be a common sequela of toxæmia of pregnancy, is no longer believed to be so. Whether pre-eclampsia leads to essential hypertension is yet debatable. Various estimates of women developing essential hypertension following pre-eclampsia or eclampsia range from 5 to 60 per cent. Browne and Dodds found a blood pressure of above 120/80 mm. in 50 per cent, and of above 140/90 mm. in 20 per cent following toxæmic pregnancy. However, Browne and Scheumack feel that pregnancy toxæmia merely hastens the onset of essential hypertension in those women who have a predisposition to it. In any case, the chance of a toxæmic patient acquiring essential hypertension increases with: (1) age at toxæmia, (2) severity of hypertension during toxæmia, (3) longer duration of toxæmia, (4) longer persistence of hypertension during puerperium, and (5) obesity.

If blood pressure returns to normal and albuminuria disappears, there is hardly any danger of toxæmia recurring in a future pregnancy. If the blood pressure persists above 140/90 mm., there is said to be a 30 per cent chance of toxæmia complicating future pregnancies. It may also be noted that one or more normal pregnancies may intervene between toxæmic ones.

Treatment

Prophylaxis. It must be stressed that toxæmia of pregnancy can be prevented in the vast majority of cases. At least, its severe form appears to be entirely preventable. Since pre-eclampsia is almost symptomless except in its severe form, vigilant, meticulous and regular antenatal supervision forms the most important means of detecting early pre-eclampsia. Prompt and vigorous treatment at the earliest suspicion of pre-eclampsia is the only sure and certain way to prevent severe forms of the disease. Every pregnant woman must have a thorough check up fortnightly in the latter half of pregnancy and weekly in the last month. Recording of the blood pressure, weighing of the patient and examination of the urine must be carried out at every antenatal examination. Patients

must be urged to report promptly the development of symptoms like oedema, puffiness of the eyelids, headache, visual disturbances, epigastric pain and oliguria.

Restricting salt intake to the minimum and preventing excessive gain in weight are important preventive measures. As pre-eclampsia is a common complication in cases of multiple pregnancy, diabetes and essential hypertension, particular attention should be paid during antenatal supervision to the appearance of early clinical features of pre-eclampsia in such cases.

Therapeutic Measures. The ideal would be to hospitalise every case of toxæmia, even the mild ones, but, in practice, lack of hospital accommodation and disinclination on the part of the patients to get hospitalised in the absence of any symptoms, necessitates treatment of many mild cases at their homes. Such patients should be explained the gravity of this complication and must be asked to report immediately if they get persistent frontal headache, or if blurring of vision occurs, or the quantity of urine becomes scanty. These patients need frequent antenatal supervision, at least twice a week, so that any aggravation of toxæmia can be at once detected and the patient hospitalised.

Treatment of Mild Cases. Rest, proper diet and diuretics form the main part of the treatment. As the blood pressure is not more than 140/90, they do not need hypotensive drugs as a routine.

These patients do not require complete rest in bed but they should be advised to have long hours of sleep at night and to rest for at least 2 hours during the afternoon. They should not be allowed to do strenuous work, and even household duties should be avoided as far as possible.

Restriction of salt intake is of no less importance than rest. Usual consumption of salt varies from 5-10 gms. per day. It can be easily reduced to 2-4 gms. by not using salt in the kitchen or at the table and avoiding salted biscuits, salted butter, salted fish, etc. Further drastic reduction in the salt intake can be achieved by using salt-free bread, dialysed milk and sodium free milk powder, but is usually not necessary. Incidentally, a pint of milk contains about 0.6 gm. of sodium chloride. Various salt substitutes or sodium free salts may be used to overcome the tastelessness of

† free diet though they are usually a poor consolation to the

• Routine hospital mixtures containing sodium salts should not be prescribed for these patients.

Fluid intake should be neither restricted nor forced. Protein rich diet with milk, eggs and meats is advisable.

Diuretics should be routinely given to every case of pre-eclampsia who has oedema, even occult. Acetazolamide (Diamox), chlorthiazide (Chlotride) and hydrochlorthiazide (Esidrex) are amongst the most effective diuretics. They should be used orally as a single daily dose, best administered in the morning. If at all a second dose is desired, it should be given in the afternoon. An evening or night dose is likely to disturb the patient's sleep by frequent calls for micturition.

Acetazolamide, being a carbonic anhydrase inhibitor, causes reduction of bicarbonate reabsorption by tubules which results in diuresis. It is likely to lead to acidosis. It can be given as a single daily dose of 250-500 mg. Chlorothiazide promotes chloride excretion and is a very powerful diuretic. Its daily dosage is 0.5-1.0 gm. Its prolonged use causes hypokalaemia. Hydrochlorthiazide is less likely to cause potassium loss and its dosage is one-tenth that of chlorothiazide. Ammonium chloride, as a traditional diuretic, is still widely used. It is best given as enteric coated tablets to avoid gastric disturbances, the dose being 35-40 gr., 3-4 times a day. It is converted into urea by the liver and the chloride ions are excreted with sodium. In view of its acidotic effect, it should not be used longer than 3-4 days, though it may be repeated after 4 days rest.

In many cases oedema gets less, the blood pressure returns to normal levels and albumen remains only as a trace. But these patients must be kept under regular antenatal supervision, at least once a week, because the toxæmia can and does recur and, perhaps, in a more severe form if vigilance is relaxed.

Those who do not improve but at the same time show no aggravation of the toxæmia are allowed to continue with the above regime of rest, diet and diuretics.

Immediate hospitalisation must be done if the blood pressure rises to 140/95 or above, or proteinuria increases, or there is excessive gain in weight.

Treatment of Moderate and Severe Cases. Whenever the blood pressure is 140/95 or more, even in the absence of marked oedema or proteinuria, hospitalisation is necessary because, besides the measures described for mild cases, constant observation is required.

The intake of fluids and the output of urine are measured. The urine is examined for proteinuria, at least twice a day.

The blood pressure must be recorded, twice a day, when it is more than 140/95, and 6 hourly when it is above 160/100.

Ophthalmoscopic examination must be carried out and, if there are retinal changes, it should be repeated every few days. Retinal changes reflect the gravity of toxæmia and should never be neglected.

Foetal heart sounds should be noted twice a day as intrauterine foetal death is always a danger. If a patient, resistant to treatment, suddenly shows quick improvement, the possibility of foetal death should always be excluded.

Hypotensive drugs can be used freely in the management of pre-eclampsia. Reserpine, 0.25 mg. orally 3-4 times a day, is very helpful in mild cases. In severe cases, it may be given intramuscularly in the dosage of 1 mg., 2-3 times a day, or can even be used as intravenous drip by adding 2.5 mg. to a pint of 5 per cent glucose. Reserpine causes peripheral vasodilatation by depressing the vasomotor centre but is not a potent hypotensive. Its action, however, persists for 2-3 weeks after the stoppage of its administration. Hydralazine (Apresoline) has the great advantage of increasing the renal and cerebral blood flow but it often gives side reactions, especially headache. It can be used intravenously and orally. 10 mg. orally, four times a day, is adequate for mild cases. Chlorpromazine is very useful, both by virtue of its hypotensive and central nervous system depressant actions. It can be used in 6-8 hourly doses of 25 mg., orally in mild cases and intramuscularly in severe cases.

Tranquillisers should be freely administered to toxæmic patients to allay their anxiety and to induce sleep at night. For sleep, it may be necessary to give some other hypnotic besides tranquillisers.

Many of our hospital patients are suffering from anaemia and hypoproteinaemia, the correction of which should form an important aspect of the management of pre-eclamptic patients.

Most of the cases of pre-eclampsia respond satisfactorily to the above therapy. The progress of the patient must be diligently observed till she improves to near normalcy. Complete return of the patient to normal in all respects, however, rarely occurs before delivery.

In cases of fulminating pre-eclampsia and imminent eclampsia, should always be forestalled by prompt and intensive therapy. $\frac{1}{4}$ gr. of morphia, given subcutaneously, can always be

relied upon for the purpose. Two gms. of magnesium sulphate, given intravenously as a 5-10 per cent solution, and 7-10 c.c. paraldehyde, injected deep in the buttocks, are also equally reliable. One of these three, either singly or alternately with others, should be used round the clock every 6 to 8 hours until the threat of convulsions recedes. This may often mean 24-36 hours watchdog attention with instant measures. Some obstetricians choose to rely on long acting barbiturates like 3 gr. of sodium amytal given intramuscularly.

At the N.W.M. Hospital, 200 c.c. of 25 per cent glucose with calcium gluconate and vitamin C is routinely given intravenously, 2-3 times a day, to severe pre-eclamptics as a liver protective. 50 per cent solution is preferred by many with the purpose of lowering the intracranial tension and inducing osmotic diuresis. Both these effects, however, are transitory.

Termination of Pregnancy. Premature onset of labour frequently occurs in cases of severe pre-eclamptic toxæmia and, though the foetus may not survive, yet it should be regarded as Nature's benevolence towards the mother.

The question of induction of labour in cases of severe intractable pre-eclampsia needs some clarification. If the patient is near term, there should be no hesitation in inducing labour. When severe pre-eclampsia occurs several weeks before term, the viability of the foetus has to be considered. Before the era of hypotensive drugs in the management of pre-eclamptic toxæmia, induction of labour was frequently resorted to in the interests of the mother and the survival of the foetus was of secondary consideration. But hypotensive therapy has considerably altered the situation. Though hypotensive therapy often fails to reduce the degree of toxæmia, it does prevent the toxæmia from becoming worse and *maintains a status quo for a considerable time. Hypotensive drugs* do not all act in the same way and, therefore, change of hypotensive drug, when one has failed to improve the condition of the mother, is sometimes successful in lowering the blood pressure.

Owing to placental insufficiency, the foetus is often poorly developed even at full term, and may not be more than 3½ to 4 pounds in weight. Intrauterine death of the foetus is likely to occur in cases of severe pre-eclamptic toxæmia but the incidence of this accident appears to be less with the present hypotensive drug therapy.

In cases of fulminating pre-eclampsia and when progressive

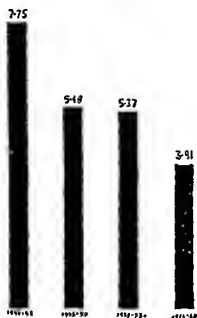
visual changes develop in a case of pre-eclamptic toxæmia under treatment, termination of pregnancy is imperative. Delay in termination would precipitate eclampsia. Severe concealed abruptio placentæ is yet another complication of delay. Oliguria and retinal hæmorrhages demand termination of pregnancy.

The mode of termination in such severe cases needs consideration. Caesarean section is the best and the quickest mode of delivery and should be resorted to in primiparae. Induction of labour by pitocin drip and rupture of the membranes takes 24-48 hours to complete delivery in a primipara, by which time one of the above complications may occur and defeat the object of termination. However, in a multipara nearing term, labour can be induced and completed within a few hours.

CHAPTER 8

ECLAMPSIA

Incidence of eclampsia in U.S.A. is 1:500-800 deliveries. Its occurrence in India is difficult to compute as it is not a notifiable disease. The incidence of eclampsia at the N.W.M. Hospital is shown in graph below.



It will be noticed that the incidence is gradually declining. This shows the improvement in the antenatal care through these years in the area catered by this Hospital.

Etiology of Toxaemia of Pregnancy

Despite the extensive work done all over the world through the last 50 years, the etiology of toxaemia of pregnancy still remains an enigma. The role of certain predisposing conditions has been realised by clinical observations since long. Primiparae are twice as liable to develop toxaemia when compared to multiparae. The probability of toxaemia is 3-4 times greater in multiple preg-

nancies than in single pregnancies. A molar pregnancy makes the patient much more prone to develop toxæmia than a normal one. Toxæmia is much more frequent in pregnancies complicated by hydramnios, essential hypertension, chronic nephritis, diabetes and rhesus incompatibility than in normal ones. Apart from these observations, a vast data of facts related to the causation of toxæmia have been collected and the number of theories claiming to unfold the etiology of pregnancy toxæmia is constantly increasing. But none of the theories offered so far can explain all the various aspects of the clinico-pathological picture of toxæmia. The following are some of the many theories put forward from time to time.

(1) **Placental Infarcts.** Fehling, in 1886, was the first to suggest a correlation between placental infarcts and albuminuria. Young, in 1914, claimed that autolysis of placental infarcts resulted in the liberation of a toxin which caused toxæmia. He particularly incriminated the red infarcts of the placenta. Bartholomew and Kracke also presented a similar hypothesis. However, in molar pregnancies with no placental infarcts, toxæmia frequently occurs. Besides, placentae from normal pregnancies also exhibit infarcts similar to those found in the placentae of toxæmic patients. Although placental infarcts are commoner in toxæmic than in normal pregnancy, this may be the result rather than the cause of toxæmia.

(2) **Intestinal Toxins.** Hastings Tweedy believed that absorption from the intestines of protein breakdown products which were not adequately detoxicated by the liver caused toxæmia. He advocated low protein diet in the treatment of pre-eclampsia and elimination treatment by gastric washouts, purgatives, enemas and high colonic lavages for eclampsia. Tweedy's hypothesis does not find much support from others and his therapy, besides being too drastic, is obsolete.

(3) **Foetal Metabolic Products.** Undue accumulation of foetal waste products in maternal circulation was believed to be the cause of toxæmia. Toxæmic patients usually show improvement following foetal death, but this improvement is better correlated with the diminution and cessation of placental function. Biochemical studies of maternal blood show no accumulation of foetal waste products. In molar pregnancy, despite the absence of the toxæmia is frequent.

(4) **Dictary Deficiency.** During the First World War, there a marked reduction in the incidence of pregnancy toxæmia

in Central Europe. This was erroneously credited to the food blockade and the resulting protein poor diet. In fact, this was the result of marked reduction in the marriage rate and hence in the number of primigravidae. It is also possible that, due to lesser medical supervision during the World War years, many cases of toxæmia might have escaped being recorded.

Theobald attributes pre-eclampsia to calcium and vitamin D deficiencies and presents experimental and clinical evidence in support. King and Ride found that gross dietetic deficiency of vitamin B is associated with an incidence of toxæmia as high as 70 per cent. Nixon shows an association between toxæmia and vitamin B₁ deficiency. Work done by People's League of Health shows that the incidence of toxæmia is about 30 per cent greater in patients with poor diet as compared to that in patients with good diet.

Dietary deficiencies seem to play a part in the causation of toxæmia, but their exact role is not as yet clear.

(5) Endocrine Imbalance. Hofbauer, in 1908, postulated hyper-activity of posterior lobe of the pituitary to be the cause of toxæmia. Hyperfunction of posterior pituitary can, through its antidiuretic and pressor substances, produce oedema and hypertension. Hoffman and Anselmino claimed that toxæmia is the result of increased amount of antidiuretic and vasopressor hormones in the blood and prepared from the blood of eclamptics a substance which caused oliguria and hypertension in rabbits. Subsequent workers have been unable to corroborate the findings of Hoffman and Anselmino. However, Teel and Reid, and later Arneil and Wilson, demonstrated an excess of antidiuretic substance in the urine of toxæmic patients. In any case, hyperactivity of posterior pituitary does not appear to be the primary cause of toxæmia. It may well be a normal compensatory physiological response to sodium retention.

Smith and Smith found excessive chorionic gonadotrophic hormone in the blood and urine of toxæmic patients and a deficiency of oestrogen and progesterone preceding and during toxæmia. This and their other work lead the Smiths to the following interesting hypothesis. The proper functioning of the placenta requires adequate levels of oestrogen and progesterone, the latter playing a role in the metabolism of oestrogen. Progesterone deficiency leads to abnormal metabolism of oestrogen resulting in the accumulation of inactive oxidation products. Normally, inactive

oxidation products of oestrogen are required for the conversion of placental chorionic gonadotrophin into oestrogen and progesterone. In toxæmia, this conversion does not take place and hence chorionic gonadotrophin concentration rises whereas that of oestrogen and progesterone falls. The placenta and the uterine decidua are rendered ischaemic by the marked reduction in the levels of oestrogen and progesterone and liberate a toxin which the Smiths called menotoxin. By virtue of its vasoconstricting and tissue destroying properties, menotoxin leads to the various symptomatology of toxæmia. Working on Smiths' hypothesis, White and Hunt administered stilboestrol and progesterone to pregnant diabetics as a prophylactic against toxæmia and found the incidence of toxæmia reduced to 5 per cent. Others could not achieve such good results. Treatment of toxæmia in non-diabetics by stilboestrol and progesterone has also been disappointing. These hormonal changes are not the primary cause of toxæmia but, at best, an intermediary in the production of toxæmia.

Toxæmia has a marked similarity to the syndrome produced by an excess of mineralocorticoids. It is tempting to consider toxæmia as one of Selye's diseases of adaptation. Lloyd et al have shown increased urinary excretion of a desoxycorticosterone-like material during toxæmia. These corticosteroid substances may be secreted by the placenta or an allied substance, such as progesterone, which is secreted by the placenta, may be converted into corticosteroids by the adrenal cortex. Much more work needs to be done to prove the possibility of any relationship between adrenal cortex and toxæmia of pregnancy.

(6) **Utero-renal Reflex.** According to Sophian who postulates this theory, toxæmia, apart from the one superimposed upon pre-existing hypertension, occurs only in association with primigravida, multiple gestation, hydatidiform mole, hydramnios and concealed accidental haemorrhage. In primigravidae, the uterine muscle resists stretching and in other conditions there is overdistension of the uterus. A nervous stimulus arising in the uterine wall due to the stretching of the uterine musculature gives rise to a utero-renal reflex resulting in a cortico-medullary deviation of renal blood flow causing ischaemia of the renal cortex as described by Trueta et al. Renal cortical ischaemia, thus produced, causes toxæmia of pregnancy with hypertension, oedema and albuminuria. The greater frequency of toxæmia in the latter weeks of pregnancy is easily explained by this theory. However, Mc-

Gaugbey et al and Abrahams and Pickford have failed to elicit the utero-renal reflex in dogs.

(7) **Uteroplacental Ischaemia.** The most widely accepted theory of the causation of toxæmia is that uterine and placental ischaemia cause cellular anoxia and liberation of metabolic toxins in the maternal blood which give rise to toxæmia. Paramore and Theobald had both propounded the theory that increased intra-abdominal pressure in primigravidae, multiple pregnancy, hydramnios, etc., leads to diminished blood flow to the uterus, kidney and liver which causes pathological changes in those organs ultimately resulting in toxæmia. Increased incidence of toxæmia, as term approaches, can be readily explained by greater possibility of uterine ischaemia. Aggravation of toxæmia during labour can be explained by the ischaemia resulting from uterine contractions. Uterine ischaemia may easily occur in molar pregnancy as the rapid growth of the uterus needs large blood supply. Eclampsia is unknown in lower animals. It is a peculiarity of the human species, thanks to the erect posture which favours increased intra-abdominal pressure and necessitates flow of blood through the uterine arteries against gravity. Besides, the blood has to flow around a hair pin bend in the uterine artery as it reaches the cervix. This theory also explains the preponderance of toxæmia in patients with chronic hypertensive vascular disease or long standing diabetes as, in both these conditions, the arteries are sclerosed and may even be calcified.

Browne and Vcall demonstrated decreased placental blood flow in pre-eclampsia and in essential hypertension by injecting radioactive saline into the placenta. Morris et al showed a reduction in the blood flow of the myometrium in toxæmic pregnancies. Smaller foetuses of toxæmic pregnancies and intra-uterine foetal deaths during toxæmia are clinical evidences of insufficiency of utero-placental blood supply. Further, Walker and Turnbull have shown that in cases of toxæmia the oxygen saturation in the cord blood was less than that in cases of normal pregnancy at the corresponding period of gestation.

The exact mechanism by which uteroplacental ischaemia leads to the development of toxæmia is far from agreed upon. It is postulated that the syncytial degeneration following placental ischaemia results in the production of a placental pressor substance (cf. renin produced by ischaemic kidneys) which causes the characteristic vasospasm and hypertension of the disease. How-

ever, no such placental pressure substance has been isolated. According to Page, ischaemic placenta liberates thromboplastin which causes toxæmia. Placenta is very rich in thromboplastin and Schneider has isolated thrombokinase from human placental extracts. Placenta contains high concentration of enzymes like histaminase and monoamine oxidase. It is suggested that inactivation of these enzymes due to placental ischaemia might result in the accumulation of histamine and adrenaline respectively. Lastly, the liberation of menotoxin of the Smiths as a result of placental ischaemia is already referred to.

Clinical Features

The term eclampsia is derived from the Greek word meaning a sudden flash. Yet it never comes as a bolt from the blue but is always preceded by a shorter or longer period of pre-eclampsia. Although eclampsia without convulsions can occasionally occur, convulsions is its most characteristic feature. For all clinical purposes, onset of convulsions is the dividing line between pre-eclampsia and eclampsia. Severe headache, visual disturbances, severe epigastric pain, oliguria and sudden rise of blood pressure are the warning signs of impending eclampsia. Aura, preceding convulsions, is uncommon. Excitability, hyperreflexia and a sensation of constriction in the chest are frequent precursors to a convulsion.

Just before a convulsion starts, the head is turned to the side and the eyeballs become fixed. Soon, the facial muscles around the mouth start twitching. Twitchings may also be noticed in the limb muscles. This *phase of invasion*, lasting a few seconds, is followed by tonic contractions of all the muscles of the body. The arms become flexed, the wrists clenched, and the legs inverted. The trunk may pass into *opisthotonus*. Respiration ceases and cyanosis develops. This *stage of tonic contraction* lasts 15-20 seconds, and is followed by the *stage of clonic contraction* in which all the muscles of the body, starting at the jaw and the face, alternately contract and relax in rapid succession. The tongue, unless properly protected, is bitten by the teeth. The patient may even be thrown out of her bed or get hurt against the railings of the bed. The face becomes congested and foam starts exuding out of the mouth. The muscular movements gradually become milder and less frequent and, ultimately, cease. The patient continues

to be cyanosed. This stage of clonic convulsions lasts a minute or two and is followed by a variable period of *coma*. In severe cases, another convulsion may follow before the patient regains consciousness. The convulsions are usually multiple, numbering 10 or more in severe cases. Even 200 convulsions have been recorded in a single patient.

When eclampsia occurs during the last weeks of pregnancy, it is said to be *antepartum*. Onset of eclampsia during labour is described as *intrapartum*. In some, it occurs within a few days following delivery and is then known as *post partum*.

Blood pressure is almost invariably high in eclampsia, often ranging to 180 mm. systolic and 110 mm. diastolic. On occasions, eclampsia does develop with systolic pressure as low as 135 mm., albeit this represents marked hypertension in a patient whose normal systolic pressure had been 90 mm. The low blood pressure may also be due to a fall of a previous high pressure due to commencing circulatory failure. Temperature rises to 101°-102°F. in many cases. In severe cases, hyperpyrexia may develop and is of grave omen. Respirations are usually rapid. Oedema is invariably present and, often, it is massive. Marked proteinuria is always present, the urine often boiling solid.

Retinal oedema, haemorrhagic retinitis and detachment of the retina, occasionally occur. But the prognosis is good, complete recovery of vision being the rule.

In antepartum cases, labour usually sets in prematurely. After delivery, convulsions usually subside and the patient gradually improves. Sometimes, however, labour does not set in, the patient recovers from eclampsia and continues to carry on the pregnancy, invariably with some pre-eclampsia. This condition is termed *intercurrent eclampsia*.

Cardiac failure, pulmonary oedema, hyperpyrexia, cerebral haemorrhage, aspiration pneumonia and *abruptio placentae* are grave complications and often prove fatal.

Differential Diagnosis

Epilepsy and hysterical fits often simulate eclampsia but can be differentiated from the history of the patient and the absence of proteinuria. It may be difficult to distinguish between uraemic convulsions and eclampsia. Convulsions or coma from cerebral haemorrhage, intracranial tumour, encephalitis, meningitis, " "

tes, hepatic failure, and acute poisoning may, on occasions, need differentiation from eclampsia. In general, one is more likely to diagnose eclampsia in its absence than miss it.

Pathology of Eclampsia

(A) Anatomical changes caused by eclampsia in the different organs are as follows:—

(1) *Liver.* On gross examination, the liver shows areas of haemorrhage and necrosis. Subcapsular haemorrhages are constantly seen and cut sections present a mottled appearance. Microscopically, there is haemorrhagic necrosis beginning at the periportal space. Thrombosis in the vessels of the periportal connective tissue is frequently seen. Apart from this characteristic periportal or peripheral necrosis, there may also be widespread midzonal and central necrosis in the hepatic lobules. The extent and degree of hepatic lesion in eclampsia is variable but bears no correlation to the clinical picture of the patient (Plate 88).

(2) *Kidney.* Kidneys are usually normal in size and may present areas of haemorrhages and degeneration on cut section. Microscopically, the typical lesion consists in the narrowing of the glomerular capillaries due to the thickening of the basement membrane and an enlargement of the endothelial cells. Degenerative changes in the epithelium of the convoluted tubules are also commonly met with. In the rare cases complicated by anuria, bilateral cortical necrosis of the kidneys can be seen.

(3) *Brain.* More than half the patients show no cerebral lesion. The various lesions met with in the brain are oedema, hyperaemia, capillary thrombosis, haemorrhages and small areas of necrosis.

(4) *Heart.* Lesions in the myocardium consist of cloudy swelling, fatty degeneration, haemorrhages and necrosis.

(5) *Lung.* Pulmonary lesions seen are oedema, congestion, subpleural haemorrhages and aspiration broncho-pneumonia.

(6) *Suprarenals.* Way found haemorrhages and necrosis in one-third of the cases of fatal eclampsia.

(7) *Capillaries.* An important feature of eclampsia is a generalised capillary thrombosis and a fibrinoid or necrotic degeneration in the walls of the capillaries.

(8) *Placenta.* Various degrees of placental infarcts, both old and recent, is a constant feature in eclampsia. Old infarcts are

white and recent infarcts are red. Retroplacental haemorrhages are often met with.

(B) **Biochemical Changes in Eclampsia.** Retention of sodium and hence of water in the body is a cardinal feature of toxæmia of pregnancy. In cases of severe oedema, blood chloride levels are reduced. Ability of the kidneys to concentrate sodium chloride is decreased during pregnancy. This ability shows a marked further decrease in toxæmic pregnancy.

Dickmann observed that there is marked haemoconcentration during the 48 hours prior to eclamptic fits.

Blood uric acid concentration is elevated in eclampsia.

Serum albumin and total proteins are lowered during toxæmia of pregnancy. During the two days preceding eclampsia, serum protein values may be increased due to haemoconcentration.

The carbon dioxide combining power of blood is usually lowered in eclampsia and acidosis follows eclamptic fits.

Prognosis

Immediate. Maternal prognosis is always serious, the mortality being 10-15 per cent. In an individual case, its severity is the most important single factor in considering the prognosis. The presence of two or more of the following indicates a severe case: (1) more than 10 convulsions, (2) deep and prolonged coma, (3) blood pressure above 200 mm., (4) temperature of 103°F or above, (5) pulse rate above 120 per minute, (6) proteinuria of 10 gm. or more, and (7) absence of oedema. However, of graver import than any of the above criteria are the development of: (1) cardiac failure with pulmonary oedema and cyanosis, (2) extreme oliguria or anuria, and (3) jaundice. Other factors weighing against the patient are the time lost between the onset of convulsions and the institution of therapy, the number of fits prior to therapy and the development of complications.

Foetal mortality is very high ranging from 40 to 50 per cent. Prematurity, asphyxia due to maternal convulsions and cyanosis, placental infarcts, abruptio placentae and trauma of operative delivery are the various factors that make the foetal outlook gloomy.

Remote. Remote prognosis is as described under pre-eclampsia.

Treatment

Eclampsia is a preventable disease. Early detection of pre-eclampsia and its prompt and adequate treatment should make eclampsia almost extinct.

The principal aim in the management of eclampsia is to stop the convulsions and prevent the possibility of their recurrence. Half a century back, it was thought that, since eclampsia occurs only during pregnancy or early puerperium, ending the pregnancy quickly by emptying the uterus would remove the cause of the disease and effect a cure. Caesarean section and accouchement forcé were then universally practised in an effort to relieve the patient from eclampsia. It was, however, soon realised that eclampsics stood surgical trauma badly and about half the deaths resulted directly from the operative procedures. Surgical measures were soon abandoned in favour of conservative methods and, today, the management of eclampsia is essentially conservative. Stroganoff, the pioneer of conservative treatment, originally recommended prolonged sedation with morphia and chloral hydrate. Later, in 1937, Stroganoff and Davidovitch advocated the combination of morphia and magnesium sulphate. Both these drugs are still widely used and form the basis of management in many clinics.

I. Immediate Management and Nursing Care. It is our practice to give intramuscularly $\frac{1}{2}$ gr. morphine sulphate on admission, after making sure that the patient has not already received it at home. Because of its quick action, good sedation and ease of administration, it is an ideal initial therapeutic measure.

The patient should be kept in a quiet room, just dark enough not to miss the facial twitchings preceding or the cyanosis following the convulsions. She should be protected from all irritating stimuli, sensory, auditory and visual. The bed must have side railings and its foot end should be raised by six inches to facilitate postural drainage of the upper respiratory tract. To prevent biting of the tongue, a mouth gag or some substitute should be ready to be inserted between the jaws at the onset of a convulsion. Oxygen should be administered after a fit till respiratory distress and cyanosis are overcome. A suction device should be handy to aspirate the secretions in the nasopharynx. It cannot be overemphasised that what the patient needs most is constant, unremitting and efficient nursing attention. Nothing else can replace this.

The detailed examination of the patient should be deferred till

she is well sedated. Blood pressure cuff should be left tied to the patient's arm and the pressure recorded, at least at hourly intervals. A self-retaining catheter should be left in the bladder and the urinary output should be measured every four hours.

II. Sedative Measures. The aim of sedation is to reduce, but not obliterate, the patient's perception of external stimuli and thus prevent the fits. Many drugs have been used for the purpose but few have stood the test of time.

Morphia. As already mentioned, this is ideal as an initial sedative measure. However, its repeated and prolonged use suppresses urinary output, increases intracranial tension and leads to acidosis by virtue of its respiratory depression.

Magnesium Sulphate. It is an efficient central nervous system and neuromuscular junction depressant and also lowers the blood pressure. It is initially given intravenously in 2 gm. dose as a 10 per cent solution and repeated 4-8 hourly depending on recurrence of convulsions and the blood pressure levels. Its injection should not be repeated if patellar reflex is absent and respirations are depressed to less than 16 per minute. Since it is excreted solely through the kidneys, it should not be employed if daily urinary output is less than 600 c.c. Ten c.c. of 10 per cent solution of calcium gluconate is given intravenously as an antidote, should respirations be dangerously depressed or cease following the injection of magnesium sulphate. Magnesium sulphate is used very freely at the N.W.M. Hospital and the results are gratifying. Many authorities use the drug as a 50 per cent solution given intramuscularly, 20 c.c. initially followed by 10 c.c. every 6 hours. Intramuscular therapy carries the risk of abscess formation at the injection site.

Paraldehyde. It is the safest and the most efficient anticonvulsant. It neither depresses respiration nor has an antidiuretic effect. Seven to ten c.c., depending on the patient's weight, is injected intramuscularly and repeated as necessary. The injection must be made deep in the gluteal muscles. It is also given rectally with equal amount of olive oil, the dose being 20-40 c.c.

Chloral Hydrate. Three gm. of chloral hydrate is given rectally as a 3 per cent solution and can be repeated 6 hourly. It is used only occasionally at the N.W.M. Hospital. It is a cardiac depressant.

Barbiturates. These produce sedation, muscle relaxation and fall of blood pressure. Sodium amytal and sodium p' . . .

VI. Post-eclamptic Management

Once the convulsions are controlled, the majority of the patients go into labour within a few days irrespective of the term of pregnancy. When severe pre-eclampsia persists, pregnancy is terminated, preferably, by caesarean section.

CHAPTER 9

NEPHRITIS DURING PREGNANCY

Acute Nephritis. Acute glomerulo-nephritis can occur during pregnancy but the association is rare. O'Dwyer and Montgomery found only 23 cases reported in the literature, while Eastman gives the incidence to be 1:5000 pregnancies.

It appears during the course or soon after an acute infection like tonsillitis or scarlet fever, streptococcus haemolyticus being a common culprit. Poisoning with heavy metals, like mercury and lead, can also lead to acute nephritis. The disease is characterised by haematuria, oliguria, proteinuria, hypertension and oedema. Spontaneous abortion may occur. During the last trimester of pregnancy, the condition needs to be differentiated from pre-eclampsia. History of preceding streptococcal infection, presence of haematuria and urinary casts leads to the diagnosis of acute nephritis.

Treatment of the condition is the same as in nonpregnant, and consists of rest, restriction of salt and fluids, and exhibition of antibiotics.

Chronic Nephritis .

Incidence. The incidence of chronic nephritis during pregnancy is 0.04 per cent or 1:2500.

Clinical Features and Diagnosis. The main features of the disease are haematuria, proteinuria, oedema and hypertension, their relative importance and severity depending upon the type of nephritis and the duration of the disease process. Persistent proteinuria during the early months of pregnancy, especially if accompanied by hypertension, should suggest chronic nephritis. When pregnancy occurs in a woman known to be suffering from chronic nephritis, there are no diagnostic problems. But when the patient is seen for the first time during the second half of pregnancy, its differentiation from pre-eclampsia becomes very difficult. Haematuria, urinary casts and evidence of renal damage go in favour of chronic nephritis. However, at times, the differentiation from pre-eclampsia becomes impossible during pregnancy.

and such cases must be followed for some weeks after delivery when the diagnosis of chronic nephritis can be confirmed by the persistence of symptoms and signs.

Prognosis. It is a progressively advancing disease. Pregnancy in a chronic nephritic is prone to be complicated by superimposed toxæmia and accidental hæmorrhage. Apart from this, the immediate prognosis depends upon the degree of impairment of renal function. Maternal and foetal prognosis in cases with renal failure, as indicated by a blood urea of over 45 mg. per 100 c.c. and marked reduction in glomerular filtration rate, is so poor that pregnancy is not worth continuing.

Management. Patients with renal failure should have their pregnancy terminated irrespective of the period of gestation.

When there is no impairment of renal function, continuation of pregnancy can be permitted but the patient must be closely watched for any deterioration or superimposition of toxæmia. Persistent deterioration in the patient's condition indicates termination of pregnancy.

Intrauterine foetal death due to placental insufficiency and accidental hæmorrhage are constant dangers to be forestalled and termination at 37 weeks is often advisable.

Those who show marked deterioration in renal function are best advised not to undertake any more pregnancies.

CHAPTER 10

ESSENTIAL HYPERTENSION DURING PREGNANCY

Essential hypertension during pregnancy is usually seen in women beyond 30 years of age. Hence, about 80 per cent of the patients are multiparae. Hereditary tendency to develop hypertension is frequently found in these cases. The condition is more commonly seen in obese patients.

Clinical Features and Diagnosis. Hypertension, as indicated by a systolic pressure of 140 mm. of Hg. or above and a diastolic pressure of 90 or above, is usually the only abnormal finding. In severe cases, the blood pressure may be as high as over 240 systolic and over 160 diastolic. Apart from hypertension, there may be no signs or symptoms. Advanced pathology of essential hypertension is generally not found at the age of maximum childbearing and, hence, secondary changes, like cardiac enlargement, retinal exudates and haemorrhages, and arteriosclerosis are usually not met with. However, in advanced cases, these may be present.

In over a third of the cases, the blood pressure falls in the middle trimester of pregnancy to rise again in the last trimester. This rise is likely to be misinterpreted as pre-eclampsia unless the patient is known to be a hypertensive. In general, systolic pressure of over 200, diastolic pressure of over 120, cardiac hypertrophy and retinopathy are indicative of essential hypertension.

Differentiation between essential hypertension and pre-eclampsia often becomes impossible during pregnancy. However, in cases of pre-eclampsia, the blood pressure returns to normal within a few weeks of delivery, whereas in cases of essential hypertension high blood pressure persists.

High blood pressure in the early months of pregnancy is mostly due to essential hypertension. But if this is accompanied by proteinuria, the possibility of chronic nephritis must be considered, and haematuria and urinary casts looked for and kidney function tests undertaken.

Superimposition of pre-eclampsia is a common complication met with in 20-25 per cent of the cases. With the advent of toxæmia, the blood pressure shows a sudden rise, proteinuria becomes manifest and oedema appears. In a few, the toxæmia may pro-

gress to eclampsia.

In a patient with essential hypertension pregnancy carries a great risk of accidental haemorrhage and the risk is markedly increased if toxæmia supervenes.

Patients with a systolic pressure of above 200 are prone to develop encephalopathies.

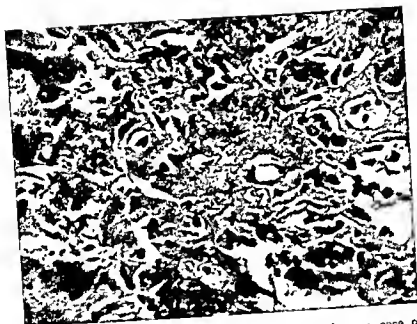
Prognosis. If pregnancy is not complicated by pre-eclampsia, it usually carries no risk for the mother. In cases with superimposed toxæmia, apart from the immediate dangers of eclampsia and accidental haemorrhage, there is increased risk of permanent aggravation of the hypertension. Foetal mortality in uncomplicated cases is 15 per cent, but it is trebled when toxæmia is superimposed.

Management. The treatment of essential hypertension during pregnancy is the same as in the nonpregnant. The patient should take as much rest as possible. Salt restriction is an important prophylaxis against toxæmia. Abnormal gain in the weight should not be permitted. Mild sedation and hypotensive drugs should be employed whenever necessary. The patient must be examined, at least, every fortnight. If toxæmia is not superimposed, the pregnancy can be safely allowed to term. If there is evidence of pre-eclampsia developing, the patient must be promptly hospitalised and adequately treated for pre-eclampsia. Further management of the pregnancy will depend on how effectively pre-eclampsia is controlled.

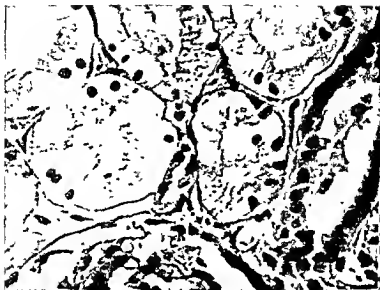
To patients who show renal damage, retinopathies, cardiac enlargement and an initial blood pressure of 200 systolic or 120 diastolic, pregnancy carries sufficiently great risk to justify its termination.

References to Chapters 6, 7, 8, 9 and 10

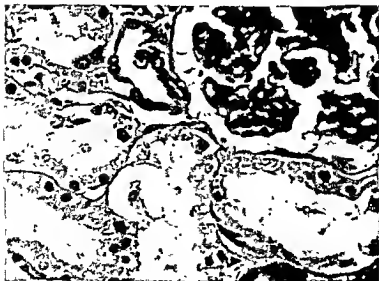
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Pl-88. Photomicrograph of a periportal necrosis from a case of
toxaemia of pregnancy (Courtesy N W M Hospital Museum,
Bombay) (p. 246)



Pl-89. Photomicrograph of cortical necrosis. (Courtesy: N. W. M. Hospital Museum, Bombay) (p. 259).



Pl-90 Photomicrograph of tubular necrosis. (Courtesy: N W M Hospital Museum, Bombay). (p. 260).

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CHAPTER 11

ACUTE RENAL FAILURE

Acute renal failure is a grave complication carrying a very high mortality. An analysis of reported cases shows that a large number of cases occur in obstetric practice. Complete suppression of urinary secretion, *anuria* is rare. Lattimer defines acute renal failure as those cases in which the urine output is consistently less than 100 millilitres in 24 hours.

Pathogenesis. Two distinct pathological conditions are responsible for acute renal failure: Acute Cortical Necrosis and Acute Tubular Necrosis. Acute cortical necrosis was described in 1898 by Bradford and Lawrence. It was believed that the only cause responsible for its occurrence was concealed accidental haemorrhage. The pathogenesis of acute tubular necrosis was recognised during World War II, when many deaths occurred from renal failure following crush injuries. The most striking difference between the two conditions is that when diffuse cortical necrosis occurs, there is no possibility of recovery as the whole nephron is dead. In tubular necrosis, on the other hand, most of the glomeruli remain undamaged, and only a part of the tubule in the region of the subcortical area is chiefly affected. Regeneration of the tubular epithelium occurs in 7 to 10 days, so that if the patient survives these critical 10 days, recovery is possible.

Cortical Necrosis. It is not a common condition and, as originally described by Bradford and Lawrence, it almost always occurs as a complication of concealed accidental haemorrhage. Occasionally, it complicates severe eclampsia.

The factors responsible for cortical necrosis are not clearly understood; but as it complicates the most severe cases of concealed accidental haemorrhage, the marked shock, present in this condition, is probably the main determining factor. Other likely factors are (1) the extent of retroplacental bleeding, (2) the absorption of thromboplastin-like substances liberated from the retroplacental clot causing hypofibrinogenaemia, and (3) excessive intra-uterine pressure in these cases stimulating the utero-renal reflex, and consequent renal vascular spasm.

Cortical necrosis is generally diffuse, and then there is no hope

for recovery, since there is no regeneration of glomerular tissue. Lesser degrees of cortical damage sometimes occur, and it is in this patchy necrosis that there is hope for recovery depending on the degree and distribution of the damage. If only a few glomeruli are put out of action, recovery is possible, though the renal function is reduced to some extent.

In cases of diffuse cortical necrosis the outer one-fourth inch or so of the kidney is whitish in contrast to the medullary portion. A narrow zone immediately beneath the capsule usually escapes necrosis (Plate 89).

Tubular Necrosis. It is a more common condition than cortical necrosis. As already mentioned, it is a more favourable process, because tubular epithelium is capable of regeneration within a week or ten days of the accident which has caused the renal failure.

The chief precipitating factor causing tubular necrosis is renal circulatory failure. Circulatory collapse following severe haemorrhage is the most important cause in obstetric practice. The circulation through the kidneys as well as other viscera, is considerably reduced in severe haemorrhage. The kidneys are particularly susceptible to anoxia, and the degree of renal damage appears to be proportionate to the duration of anoxia. It is, therefore, important not to allow prolonged hypotension in severe haemorrhage, and when suitable blood transfusion is not immediately available, hypotension should be treated without delay by other means.

Apart from severe haemorrhage in which renal circulation is considerably reduced, prolonged vascular spasm will also cause anoxia. Utero-renal reflex, caused by undue intra-uterine pressure, gives rise to renal spasm, and this prolonged ischaemia of the kidneys leads to tubular necrosis.

Necrosis of the tubular epithelium may be caused by circulating toxins, as in septicaemia, or by drugs used for inducing abortion. Septicaemia of *C. Welchii* origin is particularly likely to cause renal failure.

Haemolysis of blood from the administration of mismatched blood transfusion is a particularly likely accident in obstetric practice, when sudden circulatory collapse demands immediate transfusion of blood. Hasty cross matching and administration of unsuitable blood, has resulted in acute renal failure in many cases. Renal failure results from direct anoxia as well as from prolonged ischaemia.

It should be appreciated that though the different pathologi-

cal processes have been individually discussed as being responsible for cortical or tubular necrosis, more than one factor is in action in any one case. In abortion, hypotension from circulatory collapse, haemolysis from chemical compounds employed for procuring abortion, and septicaemia may all be acting together. Similarly, in hypofibrinogenaemia, fibrin embolisation of renal blood vessels and vascular collapse from incoagulability of blood probably combine to cause acute renal failure.

The extent of necrosis of the tubular epithelium is proportional to the gravity of the cause. In mild cases, all that may be observed on an histological examination is pigment casts in cases of mismatched transfusion, and epithelial casts in the tubules in other cases (Plate 90).

In severe cases, there is degeneration of most of the tubular epithelium, and rupture of the basement membrane.

Clinical Features. The severity depends upon the clinical cause, the extent of loss of renal function, and response to treatment. The initial phase is anuric or oliguric phase, and the patient may gradually become worse, and death may occur in 10 to 14 days. In a favourable case, this initial phase is followed by the diuretic phase and, later, by complete recovery.

Anuric or Oliguric Phase. This usually lasts for 7 to 10 days. For some days, the patient feels fairly well. The urinary output markedly diminishes within 24 hours of the catastrophe. Catheterisation draws off a little blood-stained urine, and that is the slight filtrate from the juxta-medullary glomeruli which have escaped necrosis. This small quantity of filtrate passes through the tubules which have lost their power of absorbing water.

Towards the end of the first week, clinical deterioration appears. Nausea and vomiting, with drowsiness, and muscular twitchings occur, followed by convulsions, coma and death. Oedema supervenes, but it is marked only in those cases in which large quantities of fluid are being given.

The blood chemistry shows significant alterations. The blood urea rises steadily. Serum sodium levels are frequently depressed. Administration of sodium is not indicated unless the loss of sodium is due to excessive vomiting.

Elevation of serum potassium is clinically significant. Acute potassium intoxication is a common and serious complication. The most serious effect of excess of circulating potassium is on the heart. It is reflected in the electrocardiogram, as increased ampli-

tude and peaking of T waves, especially in precordial leads a depression of the St segment, a decreasing amplitude of the R wave, and a prolongation of the QRS complex. Cardiotoxicity due to hyperkalaemia may cause sudden death from cardiac arrest.

Calcium and phosphorus levels also fluctuate. There is a rise of serum phosphorus levels with a corresponding drop in the serum calcium levels.

Hypertension is commonly observed in acute renal failure, but the blood pressure falls with the functional recovery of the kidneys.

Diuretic Phase. In favourable cases, the urine output increases, and that is usually within 7-10 days of the onset. When the urine output is more than 500 c.c., it may be concluded that diuresis has commenced. The output increases dramatically, and as much as 4 to 5 litres of urine are passed in a 24-hour period. It indicates return of glomerular function, but as the tubular function is still depressed, tubular reabsorption of glomerular filtrate does not occur, which explains the large urinary output. Loss of large quantity of water, together with loss of important electrolytes, will cause severe dehydration and electrolyte imbalance, unless the losses are promptly corrected. Though recovery has commenced, the condition of the patient continues to be serious for the next few days. The high potassium level is apt to swing to the opposite extreme, and hypokalaemia is likely to occur.

In the course of the next few days the diuresis decreases, the specific gravity of the urine increases, and there is an increase in the concentration of urea, chloride, and other substances. This is known as the *late diuretic phase*, and indicates that the regeneration of the tubular epithelium has reached a stage when it may no longer permit free flow of glomerular filtrate without selective absorption of water and other substances.

Treatment, Prophylaxis. The prevention of renal failure is evident, and in obstetric cases consists chiefly of prompt treatment of circulatory collapse, preferably by suitable transfusion of blood and, correction of hypotension by other means till blood is available.

Prompt treatment of septicaemia, particularly in cases of septic abortion, is all important. Unfortunately, the method employed for inducing the abortion is not known in many cases.

Once renal failure is recognised, indiscriminate use of fluids should be stopped, for there is no doubt, that in the past, overhydration of the patient was responsible for fatality in many cases.

Management during Anuric Phase. During the anuric phase, 24-hour intake of fluid is restricted to 400 to 500 ml. This amount, together with approximately 500 ml. of endogenous water production, is sufficient to adequately compensate for the invisible loss in the breath, in the sweat, and in the faeces.

A caloric intake of 1500 calories per day is sufficient for the daily basal metabolic needs. This amount of caloric intake is given in the form of concentrated carbohydrates. Some years ago, Bull et al advocated a non-protein, electrolyte-free mixture of fat and glucose. Bull administered 100 grammes of peanut oil and 400 grammes of glucose, with gum acacia as an emulsifying agent, and water to make 1 litre. This solution has a calorie value of 2,500 calories per litre, but it is so unpalatable that it needs to be given by an intra-gastric drip.

More recently, the fat emulsion treatment of Bull has been replaced by a simplified gastric drip of 600 to 700 ml. of water containing 100 to 400 grammes of glucose in 24 hours.

When nausea and vomiting is severe, parenteral administration of 400 to 500 c.c. of 50% glucose solution during the 24-hour period through a polyethylene catheter, passed into one of the arm veins, is adequate.

The great danger lies in the rise in blood potassium level, as it may lead to cardiac arrest. Repeated electrocardiographic records and blood estimation of sodium, potassium, and chloride should be done. A simple way of increasing blood potassium level is to give 1000 c.c. of 5 per cent glucose solution intravenously with 50 units of insulin. Conversion of glucose into glycogen carries potassium into the cells and thereby checks the rising blood potassium level.

Haemodialysis. The indications for haemodialysis are: (1) Deteriorating clinical condition of the patient as evidenced by vomiting, twitchings and convulsions. (2) A blood urea of about 400 mg. per 100 ml. (3) Increasing kalaemia of 7 m Eq./l. (4) A serum bicarbonate of 12m Eq/l. (5) Persistent anuria for 6 to 7 days.

The dialyser (artificial kidney) consists of a cellophane tube wound round a cylinder which rotates in a bath of rinsing fluid. The heparinised blood of the patient is withdrawn from the saphe-nous vein and passes through the cellophane tube where it forms a thin film on the inner surface, and then returned to the patient in a vein in the arm. A 6-8 hour dialysis reduces blood urea

nitrogen by 50 to 75 per cent. The electrolytes sodium, potassium, calcium and chlorides, rapidly return to normal during dialysis.

The great disadvantage of a dialyser is that it is a cumbersome machine, and difficult to sterilise. In any case, dialysis is a subsidiary measure to the strict control of fluid. Clinical improvement, proportionate to the reduction in the chemical levels of urea and electrolytes, results.

Management During Diuretic Phase. As the urine at this stage is merely glomerular filtrate, and as there is no absorption by the tubules, the urine is of low specific gravity, and the blood urea may continue to rise. Large quantities of potassium, sodium and chlorides are excreted, and need replacement. Sodium chloride is replaced by an infusion of saline solution, or orally by gelatine capsules containing salt. Potassium is replaced by giving fruit juices, or by giving potassium citrate orally, or by an infusion of potassium chloride intravenously. Ion exchange resins may also be useful.

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CHAPTER 12

HYDRAMNIOS (POLYHYDRAMNIOS)

The average quantity of liquor amnii at term varies between 1,000 to 1,500 c.c. In hydramnios, there is more than 2,000 c.c. of liquor, and it may be as excessive as 10,000 c.c. or even more.

Incidence. It is not possible to estimate accurately the incidence of hydramnios because when cases of only very excessive amounts causing pressure symptoms are taken into account, the incidence is low, about 1 in 1,000 pregnancies; but when cases of lesser degrees are included, the incidence would be about 1 in 200 cases.

Etiology. The cause of hydramnios is not known, but there are certain conditions in which hydramnios is frequently associated, and as these have a clinical bearing, they may be considered as possible etiological factors. It must, however, be remembered that often cases of moderately increased amounts of liquor remain undiagnosed until the gush of hind-waters after delivery make them apparent.

Developmental Abnormality. When hydramnios is very excessive, causing enormous distension of the abdomen and pressure symptoms, there is commonly some developmental abnormality of the foetus. Anencephaly is the commonest, and the excessive fluid is attributed to transudation of the cerebrospinal fluid from the exposed meninges and choroid plexus. Other abnormalities commonly associated are spina bifida, atresia of the oesophagus, bare lip and cleft palate. In hydrocephaly, hydramnios is rarely present.

Multiple Pregnancy. Hydramnios is present in about 10 per cent of the cases of twins, and it occurs more frequently in uniovular than in binovular twins. One or both the sacs may be affected. Even moderately excessive amounts in twin pregnancy cause enormous distension of the abdomen.

Maternal Diseases. With the exception of diabetes mellitus, maternal diseases are seldom responsible for hydramnios. Oakley and Peel reported hydramnios in 30 per cent of pregnancies in their series of diabetic women.

Clinical Features. Clinically, there are two varieties of hydramnios, the chronic and the acute. In the majority of cases, it is

the chronic form and fluid accumulates gradually after the 28th week. Acute hydramnios is a rare clinical condition and usually occurs before the 28th week of pregnancy.

Chronic Hydramnios

Excessive fluid begins to accumulate after the 28th week, and the clinical course depends on the amount of fluid and the rapidity with which it distends the uterus. In mild cases, the accumulation is gradual and, except for a slight discomfort, there are no other symptoms. Excessive and progressive accumulation of fluid causes pressure symptoms after the 30th week. Dyspnoea and palpitation from pressure on the diaphragm are the common symptoms, but in some, there is also oedema of the legs from pressure on the inferior vena cava.

Abdominal Examination. The uterus is larger as compared to the term of gestation, and in severe cases, at the 30th or 32nd week, the fundus is already upto the xiphisternum. The uterus becomes tense, and in severe cases, the skin over the abdomen is shiny and dry from overstretching. A fluid thrill is felt only in severe cases. Normally, the girth of the abdomen is 85 to 90 cm. at term, but in hydramnios it may be about 90 cm. at 30 to 32 weeks of gestation, and may be above 100 cm. if gestation extends to full term. In mild cases, the foetal parts can be palpated with difficulty, but in severe cases, it is impossible to make out the presentation and the position of the foetus.

An interesting case was seen at the Nowrosji Wadia Maternity Hospital in which a large hydronephrotic kidney was mistaken for hydramnios during pregnancy, and for ascites after delivery.

Vaginal Examination. The presenting part is high and can be only vaguely ballotted through the fornices. In a multipara, the tense bag of membranes can be felt through an open cervix.

X-ray Examination. As it is difficult, at times impossible, to diagnose clinically the presentation of the foetus, the presence of multiple pregnancy, or a developmental anomaly of the foetus, it is necessary to resort to x-ray examination in many cases. Malpresentation or multiple pregnancy does not materially affect the course of pregnancy, but visualisation of an anencephaly or spina bifida is of clinical value as, in the presence of these malformations, immediate termination of pregnancy is indicated.

A large ovarian cyst and ascites occasionally cause confusion,

and the finding of a foetal shadow excludes these conditions. Still greater confusion is caused when pregnancy and an ovarian cyst co-exist. A foetal shadow, situated rather to one side of the mid-line with a separate soft tissue shadow outlining the ovarian cyst, indicates the coexistence of these two conditions.

Course of Pregnancy. In mild cases, pregnancy reaches term uneventfully. In severe cases, premature labour frequently occurs. In some cases, the discomfort to the patient from excessive enlargement of the uterus is so great as to demand intervention, either by inducing labour when a developmental anomaly is present, or temporary relief by tapping a part of the excessive collection of fluid.

Course of Labour. In mild cases of hydramnios, uterine action is unaffected, and labour progresses normally, but in excessive overdistension of the uterus, labour progresses slowly. Caldeyro-Barcia has shown that excess of fluid raises the tonus and reduces the intensity of the contractions. It is a common clinical observation that in such cases progress of labour is accelerated after rupture of the membranes.

Prolapse of the cord is likely to occur when the membranes rupture, because the presenting part is frequently not engaged, and the rush of water may then bring down the cord. A vaginal examination must be made immediately after rupture of the membranes, to exclude prolapse of the cord.

When the membranes rupture the rush of waters may change the vertical lie of the foetus into a transverse lie, and therefore the position of the foetus should be carefully palpated.

Post-partum haemorrhage is said to be common, but clinical experience shows that, with proper management of the third stage, its incidence is not particularly high.

Management During Pregnancy. When a gross foetal abnormality is detected by x-ray examination, pregnancy is terminated by rupture of the membranes. If the cervix is open, fore-waters are ruptured but, in order to avoid shock from the sudden reduction of intra abdominal pressure, the flow of liquor should be controlled by keeping the fingers in the cervical canal against the membranes. When the cervix is not dilated, it will be necessary to rupture the hind-waters by introducing a Drew Smythe catheter.

Mild degree of hydramnios with a normally developed foetus requires no treatment other than rest in bed and a salt-free diet. Diuretics are of doubtful value.

A severe degree of hydramnios causing respiratory and circulatory embarrassment from pressure on the diaphragm, requires some measure to give relief. If the pregnancy is near term, labour is induced by tapping the hind-waters with Drew Smythe catheter.

When pressure symptoms develop several weeks before term, abdominal paracentesis advocated by Rivett is preferable to tapping the hind-waters, because repeated tapplings per abdomen can be done to give relief, without interrupting pregnancy. In this way pregnancy is continued for several weeks, and the premature foetus gets a chance to reach maturity.

Abdominal paracentesis is easy to perform, and does not cause any discomfort to the patient. The bladder is catheterised. The abdomen is percussed to ensure that no coils of intestine are between the uterine and abdominal walls. The abdominal wall is locally infiltrated at a point below the umbilicus in the midline and a spinal needle is inserted into the amniotic cavity. If blood is obtained, the placenta has probably been pierced and the needle is withdrawn and reinserted at a different site. The liquor amnii must be drained slowly to avoid abruptio placentae. Sufficient quantity of liquor should be removed so as to relieve symptoms, and enable palpation of the foetal parts.

Management of Labour. During the first stage, the patient is kept lying down so that even if the membranes rupture unexpectedly, the chances of cord prolapse are less than in the standing or sitting position. When the cervix has dilated to 6 cm., it is advisable to perform artificial rupture of the membranes with due care to drain the liquor slowly under control of the fingers pressed against the membranes. The presenting part is pushed into the pelvic brim by suprapubic pressure before withdrawing the fingers from the vagina.

Should the membranes rupture unexpectedly, a vaginal examination is immediately done to exclude prolapse of the cord. If the cord has prolapsed, further management is as discussed under prolapse of the cord.

The third stage is likely to be complicated by post partum haemorrhage and an intravenous injection of 0.5 mg. of ergometrine, immediately after the birth of the child, must be given.

Acute Hydramnios

It is a rare complication and usually occurs before the 28th

week. It is commonly associated with uniovular twins and foetal malformations.

Incidence. Sheth and Masani reported 7 cases of acute hydramnios in 52, 651 deliveries, an incidence of 1 in 7,521. Macafee reported 3 cases in 12,021 deliveries, an incidence of 1 in 6,010. Mueller reported 4 cases in 49,793 deliveries, an incidence of 1 in 12,448. Thus the incidence varies from 1 in 6,010 to 12,448.

Clinical Features. Symptoms appear with great rapidity. Rapid increase in the size of the abdomen, the sudden intense and increasing pain, respiratory distress, vomiting and restlessness are the chief symptoms.

On examination, the abdomen is tense and tender. It is almost impossible to feel foetal parts; foetal heart sounds are not heard because acute hydramnios usually appears before the 24th week when foetal heart is as such heard with difficulty. A fluid thrill is easily elicited. Within a few days, the uterus increases rapidly in height and girth. On vaginal examination, the cervix is soft and invariably one or two fingers dilated, through which a tense bag of membranes is felt. This is an important sign which is not sufficiently stressed.

Differential Diagnosis. Diagnosis of acute hydramnios offers no difficulty with the above described symptoms and signs developing in a matter of a few hours or days. However, at times, it can be easily mistaken for other conditions like concealed accidental haemorrhage (as in one of the cases in the present series), a twisted ovarian cyst and sudden haemorrhage in a vesicular mole.

Concealed accidental haemorrhage is differentiated by history of bleeding per vaginam in the last trimester, the presence of symptoms and signs of toxæmia of pregnancy, and increasing shock.

A twisted ovarian cyst can give rise to the same symptoms and signs, and often definite diagnosis may not be possible. However, a previous history of the presence of an ovarian cyst, acute pain in the lower abdomen, tenderness and the presence of a mass separate from the uterus, would help in a definite diagnosis. But if there is an irregular mass formed by the pregnant uterus and an ovarian cyst lying side by side, it is difficult to arrive at any definite conclusion. If the x-ray picture shows the foetus pushed to one side and a soft tissue shadow on the other side, diagnosis of an ovarian cyst is arrived at.

Sudden haemorrhage in a vesicular mole is another condition

difficult to differentiate unless a mole had been suspected prior to this accident. It is usually diagnosed at laparotomy.

Treatment. Following diagnosis, acute hydramnios requires immediate treatment as maternal distress is always great and there is an ever-present danger of sudden rupture of the sac with associated risks to the mother.

Treatment still remains a controversial point. There are two alternatives, one is to rupture the membranes from below and allow labour to ensue. *This invariably results in foetal loss.* The other alternative is to perform abdominal paracentesis to relieve the patient's distress and allow pregnancy to continue.

Eastman strongly condemns paracentesis. Macafee condemns it too and advocates vaginal amniotomy. They lay stress on very careful management of the third stage of labour, as post partum haemorrhage and puerperal sepsis are common complications. Earlier in labour, accidental haemorrhage and cord prolapse can complicate the issue.

In our view, abdominal paracentesis is not a desirable treatment as in most of these cases of acute hydramnios the cervix is already one or two fingers dilated and therefore it is doubtful whether pregnancy could be continued much longer with so much dilatation of the cervix. Also many cases of acute hydramnios are associated with gross foetal malformation. Therefore the question of the continuation of pregnancy does not arise. X-ray examination at 24 weeks is not likely to diagnose foetal abnormalities. Considering all these points, it is best to allow the fluid to escape slowly by vaginal amniotomy. The technique we employ is to rupture the membranes by a probe after inserting two or three fingers in a cone-shaped manner. The fluid is allowed to pass very slowly by keeping the fingers pressed well against the cervix. This precaution is extremely important otherwise there is the danger of sudden collapse from the rapid fall of intra-abdominal pressure. Sudden decrease of pressure is likely to cause severe post-partum haemorrhage.

Oligohydramnios

The cause of abnormally scanty liquor is not known and, fortunately, it is a rare complication. Absence of the kidneys or atresia of the urethra may be the underlying cause in some cases.

The foetus may be subjected to injurious pressure resulting in

club foot, wry neck and spinal curvatures. Intra-amniotic bands might form leading to intrauterine amputations of parts of the extremities.

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CHAPTER 13

MALFORMATION AND DISPLACEMENT OF UTERUS

Displacement of Uterus

The displacement of the uterus sometimes affects the normal course of pregnancy. The displacements having clinical significance are: (1) forward displacements, (2) backward displacements, (3) lateral displacements, and (4) downward displacements.

Forward Displacements

Anteflexion. Pregnancy occurring in an acutely anteflexed uterus is usually without clinical significance. As is common, when the acutely anteflexed uterus is underdeveloped, there is likelihood of an early abortion during the second month. Sometimes, repeated abortions occur, not so much due to acute anteflexion as due to inability of the underdeveloped uterus to enlarge with the growing ovum.

Due to pressure of the anteflexed uterus on the trigone of the bladder, frequency of urine is a common complaint during the second and the third months of pregnancy.

Pathological anteflexion is practically unknown nowadays, but in the early part of this century when ventral fixation of a retroverted uterus, was commonly performed, the anterior wall of the fixed uterus could not enlarge during pregnancy and, as a result, pregnancy, either terminated in an abortion or pregnancy, continued to advance by the enormous enlargement of the posterior wall of the uterus. As the posterior wall develops to accommodate the growing foetus, the cervix is pulled upwards and backwards, until finally, it lies high up in the hollow of the sacrum, where it is difficult to reach by the examining finger.

At the time of labour, serious dystocia is likely to occur. The presenting part is forced into the anterior pouch with the result that dilatation of the cervix is difficult, and labour is obstructed.

Hernia of Pregnant Uterus Through Weak Abdominal Wall (Pendulous Abdomen). This condition occurs in women whose abdominal wall has been weakened by a quick succession of pregnan-

cies. It is sometimes observed in primigravidae with overdistension of the uterus by hydramnios or multiple pregnancy. The heavy uterus falls forward through the overstretched anterior abdominal wall (Fig. 55).

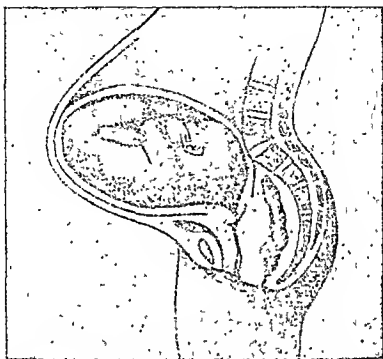


Fig. 55. Diagrammatic representation of pendulous abdomen showing misdirected foetal axis.

During pregnancy, it causes dragging pain and discomfort. Malpresentations commonly occur. Previous to the era of regular antenatal supervision, malpresentations remained uncorrected during pregnancy. During labour, malpresentation, together with the altered relation between the axis of the uterus and the axis of the pelvic brim, lead to obstructed labour.

During antenatal supervision, malpresentations should be corrected, and the patient be asked to wear a well fitting abdominal belt throughout pregnancy, and also during labour.

Backward Displacements

Backward displacement may be a retroversion or a retroflexion, but as the clinical significance does not differ, the two may be con-

sidered together. Backward displacement is the most common form of displacement met with in pregnancy. This is not surprising when it is remembered that 20-30 per cent of women have a congenitally retroverted uterus without any abnormal manifestations. In the majority of them, the course of pregnancy remains unaltered, and spontaneous correction occurs during the third month. In some, abortion occurs before the end of the third month. Occasionally, the pregnant retroverted uterus becomes incarcerated in the pelvic cavity, giving rise to pressure symptoms.

Spontaneous Correction. A mobile retroverted gravid uterus corrects itself spontaneously towards the end of the third month. Once the fundus rises above the sacral promontory, the uterus becomes an abdominal organ, and there can be no recurrence of retroversion. Generally, the patient does not have any symptoms, and many retroverted gravid uteri correct themselves spontaneously, unnoticed by the clinician.

When a retroverted gravid uterus is accidentally detected during early antenatal supervision, it should be left alone because attempts to manually correct the uterus, may start the process of abortion.

Abortion. In many cases of congenital retroversions, the uterus is hypoplastic, and abortion occurs due to the failure of the underdeveloped uterus to enlarge with the growing foetus—the backward displacement being merely accidental. When it is remembered that abortion occurs in about 10 per cent of all conceptions, irrespective of the position of the uterus, its incidence in retroversions is not particularly high. In 1948, Blackett reported the incidence of abortion in 54 cases of retroverted uteri as 11.6 per cent, and in 325 cases of anteverted uteri as 13.6 per cent. When symptoms of abortion occur, manual correction of the uterus should be gently attempted; and, if successful, a well fitting Hodge pessary should be inserted in the vagina, to maintain the corrected position until the uterus becomes an abdominal organ.

Incarceration of Retroverted Gravid Uterus. Incarceration of the retroverted gravid uterus is an uncommon complication. An overhanging promontory, or adhesions on the posterior wall of the uterus, prevent it from rising out of the pelvis. Incarceration frequently occurs without any apparent cause. As stated above, the retroverted gravid uterus normally rises out of the pelvic cavity to become an abdominal organ. But, should this not occur, the uterus continues to increase in size until it completely fills the pelvic cavity

and gets incarcerated about the thirteenth to sixteenth week (Fig. 55).



Fig. 56. Retroverted incarcerated gravid uterus.

Clinical Features. The patient complains of pain in the hypogastrium and back. Should the process of abortion commence, she will have vaginal bleeding as well. The characteristic symptoms pertaining to this complication are due to pressure on the pelvic organs.

Owing to incarceration, the anterior wall of the uterus stretches much more than the posterior wall, pulling the cervix and the anterior vaginal wall upward. The urethra and the neck of the bladder, being in close anatomical relationship with the cervix and the lower part of the anterior wall of the uterus, are also stretched. As a result, there is an increasing difficulty in passing urine and, finally, retention of urine occurs. The bladder becomes overdistended and frequently small quantities of urine are passed at frequent intervals, but the bladder is never emptied completely. This is clinically known as *retention with overflow*.

If the condition is allowed to continue, cystitis with haematuria from the rupture of small veins in the trigone develops. The author has witnessed two neglected cases of incarceration of a gravid uterus in which gangrenous portions of the bladder mucous membrane were expelled from the urethra.

Continuous overdistension of the bladder for a prolonged time may so weaken the bladder wall as to cause rupture of the viscus.

Pressure on the rectum with difficulty in defaecation occurs less frequently.

Diagnosis. Whenever difficulty in micturition is experienced during the third month of pregnancy, impending incarceration of a retroverted gravid uterus should be suspected. Frequency of urine, as a result of distension with overflow, may be misdiagnosed as cystitis; and only when retention of urine occurs is the true nature of this complication revealed.

Even before retention has occurred there will be hypogastric tenderness, and some fullness above the symphysis pubis, due to the partially distended, raised bladder. Following retention, the distended bladder will be palpated as a cystic tumour above the symphysis pubis.

On a bimanual vaginal examination, the posterior vaginal fornix will be found to be shallow. The anterior vaginal wall will be stretched and elongated. The cervix will be felt high up behind the symphysis pubis, with the external os pointing forward or even vertically upwards. The gravid incarcerated uterus will be palpated from the posterior fornix as a tense, uniform mass of elastic consistency which is practically immobile.

Differential Diagnosis. Three clinical conditions frequently confuse the diagnosis. They are: (1) pelvic haematocele, (2) incarcerated fibromyoma of the posterior wall of the uterine body or the cervix with uterine pregnancy, and (3) incarcerated ovarian cyst with uterine pregnancy.

Pelvic Haematocele. Retention of urine with amenorrhoea of 10-12 weeks is present, but on close questioning a history of one or more attacks of severe hypogastric pain, "faintness" and perhaps slight vaginal bleeding is obtained. Rectal tenesmus is a very suggestive symptom.

On abdominal palpation, after catheterising the bladder, a mass of varying size and indefinite outline may be found.

On bimanual vaginal examination, the cervix is reached with difficulty behind the symphysis pubis, and the external os is found to be pointing in a horizontal direction and not almost vertically forward as in the case of a retroverted gravid incarcerated uterus. The mass felt through the posterior fornix is of indefinite outline and of varying consistency, being firm in some parts, and soft in other parts. This varying consistency is a very important diagnostic sign of pelvic haematocele. The small uterus is palpated "riding" on top of the swelling, and may be felt high up in the hypogastrium, depending on the size of the haematocele.

Incarcerated Fibromyoma of the Posterior Wall of the Body of

the Uterus or the Cervix with Uterine Pregnancy. Retention of urine is a common symptom. On bimanual vaginal examination, the cervix is felt high up behind the symphysis. In a posterior cervical fibromyoma the external os will not be of the usual round shape, but will be "crescentic", due to pressure on the posterior lip—a characteristic shape occurring only with a posterior cervical growth. The mass in the pouch of Douglas will be hard, rounded, and in close apposition with the cervix. An incarcerated fibromyoma of the posterior uterine wall is difficult to differentiate from an incarcerated retroverted gravid uterus.

Incarcerated Ovarian Cyst with Uterine Pregnancy. Amenorrhoea is usually of less than 10 weeks, when retention occurs, in contrast to 12-16 weeks' amenorrhoea in retroverted gravid uterus. Bimanual vaginal examination is often inconclusive as the pregnant uterus and the cyst form a broad indefinite mass.

Treatment. When the patient comes under observation for difficulty in micturition, an attempt must be made to correct the retroverted gravid uterus. If the attempt is successful, the corrected uterus is kept in position for a few weeks by a pessary. If the initial attempt is unsuccessful, the patient is advised to assume knee-chest position for 15 minutes every four hours, or to lie in an exaggerated Sim's posture for an hour every six hours. As a rule, these simple measures are successful in spontaneously correcting the uterus.

When retention with incarceration has already occurred, hospitalization is necessary. The bladder should be catheterised by passing a stiff rubber catheter. Owing to elongation and distortion of the urethra, difficulty will be encountered in manipulating the catheter. In difficult cases, traction on the cervix by a ring forceps will facilitate catheterisation. The bladder is emptied slowly, by evacuating a few ounces of urine every 15 minutes. After complete evacuation, a self-retaining catheter is passed for continuous drainage, as retention will recur as long as the uterus remains in the incarcerated position. Continuous drainage, together with knee-chest posture at intervals, is usually successful and the uterus rises up into the abdomen. Very rarely is it necessary to correct the incarceration by an abdominal operation.

Lateral Displacement of Pregnant Uterus

Slight degrees of lateral displacement do not give rise to any symptom, and get spontaneously corrected. When spontaneous

correction does not occur, the gravid uterus may threaten to abort. The uterus has then to be manually corrected into the anteverted position, and the position maintained for several weeks by a pessary.

A laterally flexed pregnant uterus of 8 to 10 weeks' size is likely to be mistaken for a tubal pregnancy. The important point to bear in mind is that whenever a mass is palpated in one of the fornices, and the uterus cannot be felt separately from the mass, further observation and examination, if necessary under anaesthesia, must be done. It will then be possible to correct the laterally flexed gravid uterus into an anteverted position; the mass which was previously felt in the fornix is proved to be the gravid uterus.

Downward Displacements of Pregnant Uterus

During the early months of pregnancy a second degree of uterine prolapse will become a third degree prolapse or even complete procidentia. The further descent is due to the pressure of the enlarged gravid uterus.

The prolapsed uterus protrudes through the vulva during the early months, but, as pregnancy advances, the uterus rises up out of the pelvis, drawing the cervix upward. Frequently, what at a casual glance appears to be a prolapsed gravid uterus, is just an elongated cervix with the uterus well up in the pelvic cavity. A careful examination should therefore be made to locate the actual position of the body of the uterus. When the uterus is protruding outside the vulva with pregnancy of more than three months, it may be possible to ballot the foetus at the vulva.

Rarely does the totally prolapsed uterus get oedematous and incarcerated so as to cause difficulty in passing urine or retention of urine.

Treatment. A prolapsed gravid uterus should be replaced and kept in position by a suitable rubber ring pessary. Frequently, the perineum is so lax that the pessary does not remain in position. The patient should then be hospitalized, and kept lying down in the Trendelenberg position. After the 6th month, the rubber ring pessary is no more needed, as the pelvic brim acts like a bony ring pessary for the enlarged uterus.

Spontaneous abortion usually occurs when the prolapsed uterus becomes oedematous and irreducible.

In cases of elongation of the cervix, dilatation of the cervix during labour may be tardy, resulting in a prolonged labour.

Torsion of Pregnant Uterus

Torsion of the pregnant uterus is a rare accident of pregnancy. Nesbitt and Corner reviewed the literature in 1956, and found only 107 reported cases. There was only 1 case at the N.W.M. Hospital during the last 20 years.

Etiology. In 20 per cent of the reported cases the pelvic structures were normal. Thirty per cent of the cases occurred in myomatous uterus. In 15 per cent, there was malpresentation of the foetus. In some, there was associated ovarian cyst, adhesions of the uterus to pelvic organs, or a previous ventral suspension had been performed. In the case seen at N.W.M. Hospital the uterus was harbouring a twin pregnancy.

Preoperative diagnosis is seldom made. Abdominal pain and shock are attributed to concealed accidental haemorrhage.

Usual treatment is a caesarean section followed by hysterectomy.

Malformations of Uterus

Malformations of the uterus sometimes have an obstetric significance. As the clinical manifestations vary according to the nature of the malformation, a separate account of each of them is necessary.

Repeated abortions are likely to be due to either ill development of the horns of a double or bicornuate uterus, or due to the embedding of the ovum on the septum of a septate or subseptate uterus. Way has rightly suggested that every patient who has had unexplained repeated abortions or transverse presentations, should be subjected to radiological investigation of the uterus.

Uterus Bicornis With Both Horns Developed. Pregnancy may occur in one horn or in both the horns simultaneously. Barrett reported a case, diagnosed by x-rays, in which there was a child in each of the two horns. Khandwala reported a case of twin pregnancy in a bicornuate uterus, in which one horn contained a normal foetus and the other an anencephalic monster presenting by the breech. Cases of superfoetation have been recorded in which the two foetuses were born separately, at intervals of several days or weeks.

Pregnancy and labour are mostly uneventful, but many complications have been reported. Dystocia may occur if the non-

gravid horn gets displaced in front of the presenting part. H. DeSa reported a case in which the obstruction to the descent of the presenting part was due to the incarceration of the non-gravid uterus in the pelvis, necessitating a caesarean section. When both the horns are pregnant, the horn that has already expelled its foetus may drop into the pelvis, and obstruct the delivery of the second child.

Pregnancy in one horn may be mistaken for an ectopic gestation in the early months, and for an ovarian cyst or fibromyoma after the fifth month, because the non-gravid half is taken to be the uterus, and the other as an ectopic sac or a tumour.

Bicornuate Uterus With Underdevelopment of One Horn.

(1) *Pregnancy in Normally Developed Horn.* Usually, it is uneventful and the malformation may remain undetected. Incarceration of the rudimentary horn, with or without haematometra, may cause obstruction to the passage of the child. Due to the obliquity of the developed horn, an oblique lie of the foetus is frequent.

(2) Pregnancy in Rudimentary Horn of a Bicornuate Uterus.

Mode of Fertilization. The absence of any communication between the cavity of a rudimentary horn and the cervix of the other normally developed horn, indicates external migration of the spermatozoon or of the fertilized ovum (Plate 85).

Clinical Course. The usual termination is rupture of the horn. The duration of gestation before rupture depends upon the degree of development of the rudimentary horn. In some cases, when the horn is very small and poorly developed, rupture occurs in the early weeks, but usually there is sufficient development to allow the pregnancy to continue till 16-20 weeks before rupture occurs. Cases have been recorded where pregnancy has continued till full term. In one case at the K.E.M. Hospital, the author removed a dead foetus after 16 months of amenorrhoea. Cases of torsion of the pedicle of the rudimentary horn, with clinical features suggestive of a twisted ovarian cyst, have been recorded.

As long as pregnancy progresses normally, there are no abnormal symptoms and the condition remains undetected. In the early weeks it is frequently wrongly diagnosed as an ovarian cyst or fibromyoma, because the normally developed horn is considered to be a non-pregnant uterus, and the firm globular pregnant rudimentary horn as a fibromyoma or an ovarian cyst. With history of amenorrhoea and the above findings, an x-ray, preferably with

lipiodol injection, is helpful in the diagnosis. Malformations of the vagina, as partial septum, may also assist in directing attention to this condition. When rupture occurs, the clinical picture is like that of the "fulminating" type of ectopic gestation.

Treatment. The gravid horn is removed by clamping the ovarian ligament, the Fallopian tube, the round ligament, and the fibrous band with which it is attached to the normally developed horn.

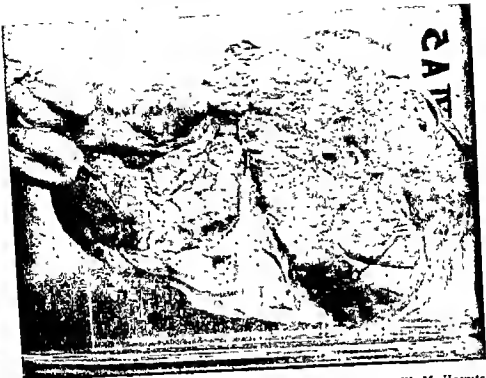
Uterus Septus. Pregnancy and childbirth are, as a rule, normal because the septum is usually thin and is easily displaced to the opposite side. If the placenta gets attached to the septum, it may fail to separate, and the diagnosis is made during manual removal when the hand passes into two separate compartments.

Uterus Subseptus. During pregnancy, a transverse lie is frequently due to the septum in the upper part. In the 12 cases reported by Way, 33 pregnancies occurred, and the transverse lie was present in 12 of them. Repeated transverse lie in successive pregnancies should suggest a subseptate uterus. When during an external cephalic version one finds that the head cannot be kept in the midline at the pelvic brim, and the breech cannot be made to cross the midline at the fundus, a uterus subseptus should be suspected. Lastly, a transverse lie with the head and the breech both close to the fundus, and the back high up above the pelvic brim, should raise the possibility of a uterus subseptus. The diagnosis is usually confirmed at internal podalic version during labour or at caesarean section.

Septate Vagina. Pregnancy and labour may be uneventful, the septum being pressed to one side during the passage of the foetus. Occasionally, it may obstruct labour, necessitating division, or it may be torn giving rise to profuse bleeding.

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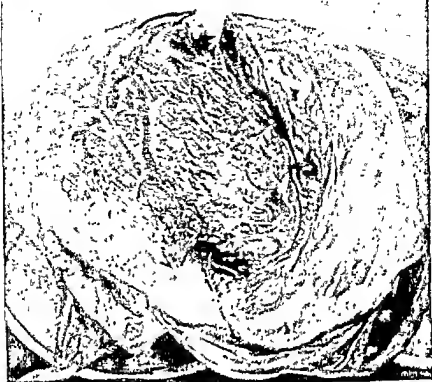
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Pl-91. Maternal surface of a bi-lobed placenta (Courtesy N W M Hospital Museum, Bombay). (p 281)



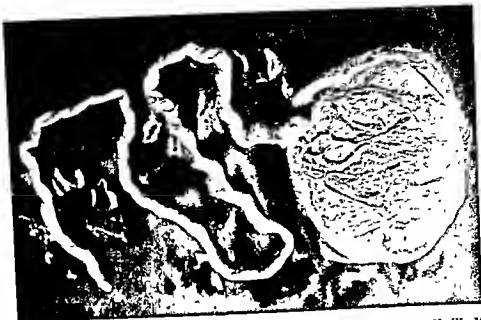
Pl-92. Foetal surface of placenta succenturiata. The succenturiate lobe is on the right. Blood vessels are seen going from the placenta to the succenturiate lobe. (Courtesy: N W M Hospital Museum, Bombay). (p. 281).



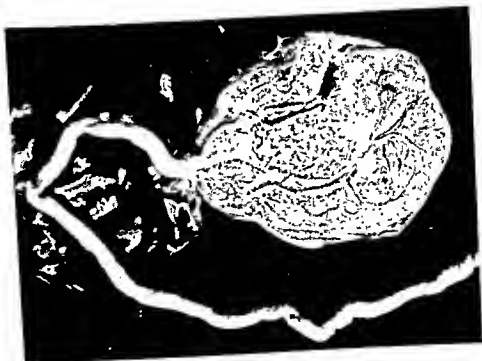
Pl-93 Placenta circumvallata (Courtesy N W M Hospital Museum, Bombay). p. 282).



Pl-94 Fibro angioma of the placenta Tumour is on the right. (Courtesy: N. W. M. Hospital Museum, Bombay). (p. 284).



Pl-95. Placenta with an abnormally long cord, 120 cm. (Courtesy N W M. Hospital Museum, Bombay) (p 286)



Pl-96. Battledore placenta. (Courtesy: N. W M. Hospital Museum, Bombay). (p. 287).



Pl-97. Placenta velamentosa. (Courtesy N W. M. Hospital Museum, Bombay). (p 288).

CHAPTER 14

ABNORMALITIES OF PLACENTA

Abnormalities of Size and Weight

Normally, the diameter of a full term placenta is 15-20 cm. (6-8 in.) and the thickness 1.5 to 3 cm. The diameter of the placenta is in the inverse ratio to the thickness which is well demonstrated in placenta membranacea.

The normal weight of the placenta is about 500 gm. (16 to 20 oz.) Syphilitic placenta is heavier, and may be double its average weight. In erythroblastosis foetalis, the placenta is dropsical, and may weigh as much as 1800 gm. (4 lbs.). Other conditions in which abnormally heavy placentae occur are, albuminuria and diabetes.

Abnormalities of Formation of Placentae

Placenta Bi-partita or Tri-partita. In this condition, the placenta is divided into two or three lobes separated from each other by narrow clefts. The blood vessels pass from one lobe to the other, and finally unite to form the cord which has a marginal insertion (Plate 91).

Placenta Duplex or Triplex. In this condition, the lobes, two or three, more or less of equal size, are wholly separate from each other. The blood vessels from one lobe pass between the membranes to join the blood vessels of the other lobe.

The principal importance of accessory lobes lies in the velamentous vessels which are usually carried in the membranes between the lobes. Should such velamentous vessels cross the internal os, "vasa praevia", foetal haemorrhage with exsanguination may result from their rupture during delivery.

Placenta Succenturiata. This is a variant of the bilobed placenta in which one lobe is much smaller than the other. Such a detached small lobe is known as succenturiate lobe. The succenturiate lobe is united to the main portion of the placenta by blood vessels coursing through the membranes (Plate 92). The clinical importance lies in the tendency of the succenturiate lobe to be re-

tained inside the uterus after the main body of the placenta has been expelled. It may give rise to immediate post partum haemorrhage, or the bleeding may occur later. Examination of the expelled secundaries reveals a small round defect in the membranes some distance from the placental margin, and vessels will be seen extending from the edge of the expelled placenta across the membranes to the margin of the tear in the membranes. In such cases, manual removal of the retained lobe must be done immediately, to avoid the risk of haemorrhage.

The greater danger of a retained succenturiate lobe is its separation some hours after delivery, at a time when haemorrhage is not expected. In some cases, secondary post partum haemorrhage occurs some days after delivery.

Succenturiate lobe may be retained in utero, and subsequently form a placental polyp, giving rise to irregular profuse blood loss.

Placenta Fenestrata. It is so called as there is a gap in the placental tissue covered by the membranes, giving an appearance of a window.

Placenta Circumvallata. Placenta Marginata (Placenta Extrachorialis). Scott, in 1960, reviewed in detail the incidence, anatomy, etiology, and clinical significance of placenta circumvallata and suggested a comprehensive name, *placenta extrachorialis*, for these developmental varieties.

Scott defines placenta extrachorialis as a condition in which the transition from the membranous to the villous chorion does not occur at the margin of the placenta, but at a variable distance within the circumference of the placenta. A complete ring divides the foetal surface into a central and a peripheral zone. The ring is yellowish-white in colour, slightly raised, and is about 1 cm. broad. Placenta marginata is one in which there is only a thin fibrous ring where the blood vessels on the foetal surface appear to terminate. When a double layer of amnion and chorion is folded towards the centre of the placenta, it is called placenta circumvallata (Plate 93).

In a series of 3,161 consecutive placentae examined by Scott, 578 (18 per cent) were placenta extrachorialis. Half of these showed extrachorial ring of haemorrhage.

In placenta extrachorialis, the portion of chorion from which the villi have origin (chorionic plate) is smaller in area than the basal (decidual) plate of the placenta. A ring of blood clot or fibrin

is frequently present at the margin of the chorionic plate, and is situated within the membranous fold. This haemorrhagic margin is sometimes erroneously considered to be a marginal sinus.

A number of divergent theories have been put forward to explain this developmental anomaly, but the two basic processes are: (1) an original chorionic plate smaller in area than the decidual plate and (2) repetitive later haemorrhages reducing the area of the chorionic plate.

Placenta extrachorialis has no clinical significance for the foetus or the mother, unless there is an extra chorial ring of haemorrhage. It may then give rise to antepartum bouts of bleeding, simulating placenta praevia.

Marginal Sinus. The existence and function of the marginal sinus has been a much debated question. The term marginal sinus was postulated by Spanner in 1935. His concept of the maternal blood circulation in the intervillous space was, that the spiral arterioles open into the intervillous space through perforations in the decidual plate. The blood then passes laterally toward the margin of the placenta where most of the venous drainage occurs along a continuous circular sinus (marginal sinus). With newer injection technique, Hamilton and Boyd in human, and Ramsey in rhesus monkey have confirmed Spanner's concept as far as arteriole inflow in the intervillous space; but they have been unable to demonstrate the presence of a marginal sinus as the site for venous drainage.

The marginal sinus has been confused with the marginate or circumvallate ring of the placenta extrachorialis. In both, repeated haemorrhages occur during pregnancy, simulating placenta praevia. Scott states that an anatomically correct definition of such haemorrhages would be, "haemorrhages from the edge of the chorionic plate of the normally implanted placenta".

Though the haemorrhages from the margin of the normally implanted placenta may recur and may be quite considerable, there is little risk to the mother or the foetus. It is therefore quite necessary to try and locate the site of the placenta in such cases, and it would be safe to allow the patient to go home when the placenta is visualised in the upper part.

Placenta Membranacea. In this rare condition most of the chorion laeve fail to atrophy, and the ovum is covered by functioning villi all over. The placenta is thin and membranous, and covers a large portion of the chorion. In this condition the placen-

tal tissue is often considerably thinner than in the usual placenta, but its over-all mass may be the same, atleast in weight.

The thinned out diffuse placenta does not readily separate, and manual removal is frequently necessary. Partial separation of a membranous placenta gives rise to post partum haemorrhage. A membranous placenta often occupies the lower region of the uterus, and is then like a placenta praevia, and may give rise to antepartum haemorrhage.

Calcification of Placenta. Not uncommonly, small white gritty deposits are observed on the maternal surface of the placenta. They are composed of calcium carbonate and phosphate, and magnesium phosphate.

Calcification helps in locating the site of the placenta by x-rays.

Benign Tumours of Placenta. Motasbaw reviewed the literature while reporting from N.W.M. Hospital, Bombay, a case of fibroangioma (Plate 94). According to her, the total number of reported cases, including hers, is less than 240. The apparent low incidence may be due to the fact that cases are being missed, particularly where the tumour is small and embedded deeply in the substance of the placenta.

In many cases hydramnios is present. These tumours are small in size and do not complicate labour, but cases have been reported where the tumour was sufficiently large to interfere with the progress of labour.

Placental Infarcts

In general pathology, the term 'infarct' is applied to a localised area of necrosis resulting from obstruction to its blood supply. Until recently, placental infarct was a loose term applied to almost any placental discolouration. Many of these lesions are physiological due to normal senility of the placenta, and a few only can be strictly regarded as 'infarcts'. These true infarcts result from accidents to either the maternal or the foetal blood vessels. Therefore, these changes which cause multiple red or white areas are conveniently described as: (1) physiological degenerative changes, and (2) pathological, due to accidents to the maternal vessels.

(1) **Degenerative Changes in Placenta.** The placenta has a limited life cycle corresponding to the duration of pregnancy. It grows actively during the first seven months of gestation, and

thereafter until term gradual senile changes occur. The primary senile change is the degeneration of the syncytium as a result of which the maternal blood in the intervillous space has a tendency to clot.

Fibrinoid Degeneration. The subchorionic deposition of fibrin is seen in nearly every placenta during the third trimester. Flat white plaques, 1 to 2 mm. in size and from 2 to 5 mm. in thickness, are formed. These areas frequently coalesce to form large areas of yellowish-white tissue. They usually occur on the maternal side of the chorionic plate, and near the septa.

According to Crawford, white infarcts are due to endarteritic changes in the intradecidual foetal vessels, and deposition of fibrin around the vessels. Another explanation for these white infarcts is that the syncytium lines the intervillous space, and is analogous to the endothelial lining of blood vessels. As long as the syncytial lining of the intervillous space remains in active growth, the maternal blood flowing along it remains unaltered. The evidence of aging of the placenta is the degeneration of the syncytium which occurs in the grouping of nuclei in small areas on one side of the villus, commonly called syncytial knots. As a result of degeneration and loss of epithelial lining of the intervillous space in places, blood clots and fibrin is deposited.

As a rule, these small areas have no clinical significance, but sometimes extensive deposition of fibrin forms large areas so that insufficient normal placental tissue remains for the nutrition of the foetus. The placenta has considerable reserve, and not until more than a third of the placenta has been rendered functionless that the nutrition of the foetus is likely to suffer. These small areas of fibrinoid degeneration have been erroneously called "white infarcts". As a result of fibrin deposition other secondary changes occur which are given below.

Ischaemic Necrosis of Villi due to Fibrin Deposition. One of the results of fibrin deposition is that the fibrin may surround the whole villus, and thus isolate it from its nourishment from the maternal blood. By isolation of many villi a firm, granular, irregular area, yellowish white in colour, is formed. Microscopically, chorionic villi surrounded by fibrin are seen. The chorionic vessels may show changes of endarteritis, or complete occlusion depending on the age of the lesion.

Intervillous Thrombosis. As a result of syncytial degeneration, sudden coagulation of blood in the intervillous space may

occur. As a result, a laminated blood clot is formed beneath the decidua plate. The clot is firm, reddish brown in colour and is called a 'red infarct'. Later, the affected area becomes organized, and is then called 'white infarct'. Still later, calcification occurs which can be seen as small, white, gritty areas on the maternal surface of the expelled placenta. These areas of calcification are frequently visible in radiographs taken at term.

Pathological Changes due to Accidents to Maternal Vessels. The lesion is due to the rupture of the thin-walled blood vessels in the decidua basalis, as a result of which there is extravasation of blood in the decidua and the formation of a haematoma. A small retroplacental haematoma is not clinically significant as the nutrition of the foetus is unaffected by the separation of a small area of the placenta. A depressed area on the maternal surface of the placenta is frequently seen. A recent or old blood clot may be present on the area, signifying the duration of the haematoma before delivery.

Extensive haematoma in the decidua basalis causes detachment of a large area of the placenta and foetal death. This accident is called *abruptio placentae*, *ablatio placentae*, or *retroplacental apoplexy*, and is described under accidental antepartum haemorrhage.

It may be associated with pre-eclamptic toxæmia, or may be non-toxaemic in etiology. The causation of haematoma in the non-toxic group is not known, and many theories have been advanced, none of which is satisfactory.

Anomalies of Umbilical Cord

Length. The normal length of the cord is about 50 cm. (20 in.). When the placenta is attached high up in the uterus, the cord must be long enough to allow the umbilicus to be born and that length must at least be 35 cm. (14 in.).

Abnormally Long Cord. A cord, as long as 180 cm. (72 in.), has been reported. A long cord may coil about the body of the foetus, but does not, as a rule, affect the circulation of the foetus. A long cord has a greater tendency to prolapse during labour (Plate 95).

Abnormally Short Cord. One has to distinguish between an absolute shortening from a relative shortening of the cord.

A cord that is too short, sometimes, causes delay in the progress of the second stage of labour. A short cord can be clinically

suspected when (1) the foetal heart sounds become irregular, and (2) the descent of the bead during a pain is slow, and the bead recedes quickly towards the end of the contraction. Frequently, forceps delivery has to be resorted to, either for prolonged second stage or for signs of foetal distress.

Other rare accidents resulting from a very short cord are:

(1) *Inversion of Uterus*. Inversion occurs as the foetus is being born. Inversion may be partial or complete, with the placenta still attached to it.

(2) *Premature Separation of Placenta, Abruptio Placentae*. This accident frequently causes sudden death of the foetus in utero. The placenta follows immediately after the birth of the child, with large quantities, 15 to 20 oz., of retroplacental clots.

(3) Cases have been reported in which the cord was only a few inches in length. Rare cases of absence of cord have been recorded in which the umbilicus, through an umbilical hernia, had been attached directly to the placenta.

Relative Shortening of Cord. This occurs when a loop or loops of the cord are wrapped round the neck, body or the limbs. A single loop of the cord round the neck is commonly found and, in most cases, the loop is loose and can be slipped over the head or over the shoulders immediately after the head is born. When there are two or more loops coiled round the neck, there is much more relative shortening of the cord. It is not possible nor is it advisable to attempt to slip the loops over the head or the shoulders, as in the case of a single loop because in attempting to undo one loop the others get tightened round the neck and cause asphyxiation of the baby. It is therefore necessary to first clamp the cord in two places, cut the cord in between, and then undo the loops.

Abnormal Insertion of Cord into Placenta. Ordinarily, the cord is attached at or near the centre of the foetal surface of the placenta, but two types of eccentric attachment are commonly observed.

(1) *Battledore Placenta*. In this case, the cord is inserted into or near the margin of the placenta. It has no clinical significance (Plate 96).

(2) *Velamentous Insertion of Cord*. In this type, the vessels of the cord separate some few centimetres from the placenta. After leaving the cord, they run between the membranes. Velamentous insertion is due to the placenta having developed away from the

point of insertion of the cord (Plate 97).

The clinical significance of velamentous insertion of the cord is only when the placenta lies in the lower segment, because then the vessels may cross the membranes covering the internal os. This condition is known as *vasa praevia*. Rupture of these vessels crossing the dilating os is inevitable, and may result in the death of the foetus. Vaginal bleeding, as a result of *vasa praevia*, is distinguished from bleeding due to placenta praevia by observing that, in spite of the large quantity of bleeding, the general condition of the patient does not deteriorate as the blood loss is from foetal circulation. Microscopic examination of the blood lost demonstrates nucleated foetal red blood corpuscles.

It is stated that velamentous insertion of the cord occurs nine times more frequently in twins than in single pregnancies, and that it is always present in triplets.

Rupture of Cord. When precipitate labour occurs, with the mother in the standing position, the foetus may be so forcibly expelled as to cause rupture of the cord.

Rupture of the vessels of the cord in *vasa praevia* has already been described.

If care is not exercised to palpate the presence of an occult loop of cord by the side of the head, before applying the blades of the forceps, the cord may be nipped between the head and the blade of the forceps and rupture.

Absolute or relative shortening of the cord may cause such undue traction on the cord during the birth of the child, as to rupture the cord.

Knots of Cord. *False knots* are formed by irregular thickening of Wharton's jelly at one or more places, and do not have any clinical significance (Plate 27).

True knots are sometimes seen, but seldom cause asphyxia of the foetus because intravascular pressure tends to keep the knots loose, and thus prevents interference with the circulation within the cord (Plate 27).

Hernia of Cord. Sometimes, there is a hernial sac by the side of the cord which may contain a loop of intestine or omentum. Such congenital umbilical hernia may extend several centimetres into the cord, and therefore care should be taken while tying the cord. As a precautionary measure, the cord should always be tied about 7-8 cm. away from the umbilicus.

Inflammation of Cord. Inflammation of the cord prior to birth occurs only after foetal death. The infection may be syphilitic or pyogenic. Wharton's jelly is infiltrated with leucocytes, and the obliterative changes in the vessels are due to infiltration of leucocytes into the tunica adventitia.

Neonatal infection of the cord occurs from lack of proper aseptic care at the time of delivery or during the first few days following birth. In India, infection by tetanus bacillus sometimes occurs when the delivery is managed at home by untrained women or by 'dais'.

New Growth of Cord. In 1951, Barry reported a case of tumour of the umbilical cord, the only one reported. The tumour was encapsulated, devoid of chronic elements and containing endothelial cells. It was attached by a pedicle to the umbilical cord. The tumour was associated with polyhydramnios and premature delivery.

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SECTION VI

DISORDERS ASSOCIATED WITH PREGNANCY

CHAPTER 1

HEARTBURN

More than half the number of pregnant women suffer from heartburn. It commences at about the fifth month of pregnancy and is very severe upto the eighth month; and in most of them spontaneous relief occurs during the last three or four weeks.

There is no definite knowledge regarding the causation of heartburn. It has been attributed to elevation and retation of the stomach upwards as the uterus rises in the abdomen. As a result there is delay of 1 to 2 hours in emptying of the stomach as compared to normal. The wide spread atony of the smooth muscle during pregnancy, may also be the reason for delay in the emptying of the stomach.

In heartburn, intense burning pain is felt behind the lower half of the sternum due to regurgitation of the semidigested gastric contents into the lower part of the oesophagus.

Treatment. Heartburn is best treated by giving preparations containing aluminium hydroxide. Alkaline powders are also useful in giving relief.

Disorders of Liver During Pregnancy

Jaundice during pregnancy should always be regarded with concern and promptly investigated. All pregnant women who develop jaundice should be hospitalized. Jaundice, during the first and second trimesters of pregnancy, is usually caused by virus hepatitis, and its course is similar to that in the non-pregnant state. But, jaundice in the third trimester often takes a fulminating course and carries a very high mortality. In the undernourished women of India, hepatic failure sets in rapidly. In 1949, there was an epi-

demic of virus hepatitis in Bombay and, in the N.W.M. Hospital, no less than 49 deaths in a total of 95 deaths during the year were due to jaundice and hepatic failure.

Liver Function During Pregnancy. Liver function during pregnancy has been investigated by many workers, and the results of tests have been found well within the normal range, or minor deviations from the normal have been observed.

The pattern of serum proteins is altered during pregnancy. The level of serum albumen decreases, but there is an absolute and relative increase in the alpha and beta globulins, and a slight decrease in gamma globulin. In some cases this pattern does not revert to normal until several months after delivery.

The serum cholesterol level during pregnancy has been studied by McNair and Jaynes. It commences to increase at the fourth month, and the peak is reached by the eighth month. The cholesterol level exceeds 250 mg. per 100 ml. in 57 per cent of women during late pregnancy, and may even reach as high as 400 mg. per 100 ml.

The alkaline phosphatase levels during pregnancy have been studied by Speert et al. The alkaline phosphatase levels begin to rise in the first trimester, and is three times the initial value at term.

Thorling studied bilirubin levels in 202 pregnant women, and found it well within normal limits.

Classification. Classification of hepatic disorders during pregnancy is difficult. The commonest cause is *viral hepatitis* which, because it runs an acute course during pregnancy, requires special consideration.

Hepatic disorders related to pregnancy were divided by Sheehan in 1940 into three main groups:

(1) *Obstetric acute yellow atrophy* was described in detail by Moore in 1956, and he designated this condition as *acute fatty liver of pregnancy*. (2) *True acute yellow atrophy* (acute hepatic necrosis) was formerly regarded as a complication of severe pre-eclampsia or eclampsia, but nowadays many authorities consider it as a complication of viral hepatitis. (3) *Delayed Chloroform Poisoning*. Thirty years ago, chloroform was widely used in obstetric practice, and cases of fatal acute hepatic necrosis were occasionally met with. With the introduction of modern anaesthetic drugs, chloroform has been completely eliminated as an anaesthetic agent, and cases of delayed chloroform poisoning are practically

unknown.

Thorling in 1955 described a type of jaundice occurring in late pregnancy which he named as **obstetric hepatitis**.

Haemolytic jaundice is occasionally observed as a result of incompatible blood transfusion given in an obstetric emergency. Infection by *Cl. Welchii* is rare, but when it occurs, jaundice as a result of blood haemolysis appears as a terminal event.

Acute cholecystitis, gall stones, and Spirochaetal jaundice (Weil's disease), are occasional causes of jaundice during pregnancy.

Viral Hepatitis

Viral hepatitis during pregnancy may be sporadic, but when there is an epidemic, its incidence during pregnancy increases correspondingly. When viral hepatitis occurs in the first or the second trimester of pregnancy, its course is similar to that in non-pregnant patients; but it is a grave complication during the third trimester, when the disease frequently runs a fulminating course.

Incidence. The incidence of viral hepatitis is greater in countries where chronic malnutrition is prevalent. Zondek and Bromberg reported 29 cases during an epidemic in Israel among 3,382 obstetric patients, giving an incidence of 0.85 per cent.

Two viruses, known as virus IH and virus SH, are responsible. Virus IH is present in the blood and faeces of patients, and its spread is by direct contamination from faeces, or by partaking of contaminated food. Virus IH is the one usually responsible for virus hepatitis. Virus SH causes 'serum' or 'syringe' jaundice, and occurs when transfusion of whole blood from a carrier donor is given, or by the use of a contaminated syringe or needle for the injection of drugs, or withdrawal of blood for testing.

The incubation period of virus IH is from 2 to 6 weeks, whilst that of virus SH is from 2 to 6 months.

Clinical Features. Several days before icterus develops, the patient runs a low fever up to 100°F. with lassitude, mild epigastric pain and vomiting. These symptoms in the first trimester of pregnancy are usually attributed to gastric disorder of early pregnancy. In an epidemic, these symptoms are taken notice of as heralding an infective hepatitis. In a mild form of hepatitis, the temperature subsides by the time icterus becomes clinically apparent. Pruritus is not a prominent symptom.

Jaundice being obstructive in type, the stools become pale in colour due to lack of bile pigments; the urine is dark coloured due to the presence of bile pigments. The alkaline phosphatase is raised but is seldom above 25 King-Armstrong units. There is a fall in serum albumen, with an increase in gamma globulin. The various flocculation and turbidity tests, which depend on alterations in the serum proteins, show raised values.

Effect of Virus Hepatitis on Pregnancy. It depends on the severity of the attack. In mild cases of virus hepatitis, abortion or premature delivery rate is a little greater than the average obstetric rate. But in virus hepatitis epidemics, severe forms usually occur, and abortion or premature delivery is extremely common. The clinical condition does not apparently improve after abortion, or premature labour.

Effect on Foetus. There is no convincing evidence to suggest that virus hepatitis, developed by the mother during the first four months, can result in foetal abnormalities. Both varieties of viruses can cross the placental barrier and cases of neonatal jaundice have been recorded. Perinatal mortality is high, mostly because of prematurity, and in only an occasional case intrauterine death of neonatal death is due to foetal hepatitis.

Pathology. Pathological changes in virus hepatitis are variable. Liver biopsy in some cases reveals no abnormalities. In others, there are marked changes in the liver architecture, with variations in size of the liver cells and their nuclei. Periportal infiltration by lymphocytes, polymorphonuclear cells and histiocytes is seen. As the reticulum frame work of the lobules is preserved, the liver cells regenerate in spite of considerable necrosis.

Acute Fatty Liver of Pregnancy and Acute Yellow Atrophy (Acute Hepatic Necrosis)

Though the pathology of these two conditions is entirely different, they are clinically indistinguishable, and are therefore best considered together.

Pathology. (A) **Acute Fatty Liver of Pregnancy.** The liver usually weighs a little less than normal. The average weight in the cases studied by Sheehan in 1940, and by Moore in 1956, was between 1,040 and 1,300 gm. The liver is of a uniform pale colour, and in some, there are subcapsular haemorrhages on the surface of the liver.

Histology. The lesion affects the central portions of all the lobules. The liver cells surrounding the central vein are swollen, vacuolated, and appear tightly packed together. The cytoplasm of the affected liver cells is broken up into innumerable fine vacuoles. The nuclei in the foamy cells are normal. Sudan stain gives the reactions of neutral fat. It is distributed as a fine foam throughout the cytoplasm, and not as large globules which are characteristic of fatty infiltration.

The extent of fatty change varies from case to case, but even in the most extensive cases there is always a narrow periportal rim of liver cells which are quite normal.

Bile pigment is present in the liver cells. Bile thrombi are found in the bile canaliculi between the foamy cells.

Infiltration by polymorphonuclear leucocytes and mononuclear cells is not a prominent feature.

The nature of the liver lesion is not known. Moore has discussed this in detail, as also the clinical pathology of this condition.

(B) *Acute Yellow Atrophy of Liver (Acute Hepatic Necrosis).* The liver diminishes rapidly in size and, within a comparatively short time, becomes less than one-half of the normal. The capsule is wrinkled as a result of rapid shrinkage in size. On section, it appears dark, almost chrome yellow in colour.

Histology. In mild cases, the centre of each lobule undergoes necrosis, while the cells of the periphery are normal in appearance. In severe cases, almost the entire parenchyma of each lobule is destroyed and is replaced by a mass of necrotic debris. The interlobular spaces with their blood vessels and biliary canals show little change.

Clinical Features. These occur in the last trimester of pregnancy. The onset of jaundice is sudden, and is associated with severe epigastric pain, vomiting, and headache. The condition rapidly deteriorates with the jaundice getting deeper and the above symptoms getting aggravated. The vomits become coffee-ground in colour.

Mental symptoms soon develop and to start with, there is confusion with hallucinations. Very soon the patient lapses into a deep coma, with dilated pupils, and inco-ordinated movements of the eyes. Within 7 to 12 days after the onset, delivery of a premature still-born foetus occurs.

Treatment. Prolonged rest in bed is essential. The diet should be rich in carbohydrates and proteins, and of low fat content. Cho-

line and methionine are contraindicated, as they are not metabolized by the damaged liver and are toxic to these patients.

Steroid hormones, cortisone in doses of 100 mg., three to four times a day, are usually given; but it is doubtful whether they influence the course of the illness.

Antibiotics are of no specific value except when bacterial infection complicates the disease. However, aureomycin and terramycin are commonly employed.

There is no indication for termination of pregnancy. Vitamin K should be given at full term, but if the liver cells are damaged the injected vitamin may not be utilised for the formation of prothrombin. There is risk of post partum haemorrhage, and all preparations, including suitable blood, should be kept in readiness.

Weil's Disease (Spirochetal Jaundice)

The disease is of acute onset and, besides the usual clinical features, muscular pains in the limbs is a prominent symptom. Subcutaneous haemorrhages, and injection of conjunctivae is often observed. Albuminuria is almost always present with red blood cells in the centrifuged deposit. Examination of the blood shows well marked leucocytosis, which is not the case in viral hepatitis. The presence of agglutinins in the patient's blood, confirms the diagnosis.

Jaundice Resulting from Use of Drugs

In modern obstetric practice, liver damage due to anaesthetic agents is rarely seen because of the elimination of chloroform as an anaesthetic agent. Chloroform poisoning used to figure prominently in text books of bygone days.

The use of chlorpromazine for controlling vomiting of early or late pregnancy sometimes acts as a hepatic toxin. The jaundice is of the obstructive type, and liver function tests do not show evidence of hepatocellular damage. Soon after discontinuing the drug, jaundice begins to disappear. Liver biopsy does not reveal damage to the parenchymal cells.

Obstetric Hepatosis (Recurrent Jaundice in Late Pregnancy)

In 1955, Thorling reported 72 cases of jaundice in the last trimester of pregnancy.

The disease runs a mild afebrile course without any maternal deaths. In 90 per cent of the cases the onset was with generalised pruritus, which preceded other symptoms, sometimes by several weeks. Jaundice develops to a maximum in 7 days, and persists until delivery. Within a day or two after delivery, it begins to diminish.

Liver biopsy shows hepatic cells and dilated bile capillaries containing bile thrombi. Svanborg reported a series of 7 cases in which jaundice occurred in successive pregnancies.

So far this clinical entity has been reported from Scandinavian countries.

Haemolytic Jaundice

Haemolytic jaundice is rare during pregnancy, except for such accidents as mismatched transfusion or infection by *Cl. Welchii*.

The haemolysis of red blood cells is so rapid that the liver is unable to conjugate or excrete bilirubin as it is formed. The accumulation of unconjugated bilirubin in the blood causes jaundice. The urine contains urobilinogen but no urobilin. The stools are dark from excess of stercobilin.

Appendix in Pregnancy

Appendicitis is a grave complication during pregnancy and carries a higher mortality than in the non-pregnant. The incidence reported by different authors varies between 1 in 1500 to 1 in 2000 deliveries. Most cases occur during the first six months of pregnancy, and the incidence is much less during the last trimester, labour, and the puerperium.

As the uterus increases in size, the caecum and the appendix are displaced upwards and laterally, and at the sixth month the appendix lies at the level of the iliac crest, and higher still during the last trimester. This upward displacement alters many of the clinical signs normally observed. Localisation of the infection is hindered by the omentum being displaced upwards. The uterus forms the medial wall of an appendicular abscess, and the inflammatory reaction is likely to induce abortion or premature labour. The sudden reduction in the size of the uterus following abortion or delivery may cause bursting of a localised abscess, precipitating a generalised peritonitis.

Clinical Features. The clinical features differ in some respects from that found in the non-pregnant state. At the onset there is pain in the right half of the abdomen with a rise of temperature. Nausea and vomiting frequently occur, and in the early months of pregnancy these symptoms are likely to be mistaken for discomforts of pregnancy.

Owing to upward displacement of the appendix, tenderness on the right side is elicited higher than usual, and the right flank is frequently tender as well. Due to physiological lack of tone, the rigidity of the abdominal muscles is not conspicuous.

In a normal pregnancy, the leucocytic count is raised to as much as 12,000 per c.mm., and therefore a leucocytic count is of help only when it is more than 15,000 per c.mm. The sedimentation rate is also increased in a normal pregnancy, and is therefore of not much help.

Differential Diagnosis. The chief difficulty is in distinguishing appendicitis from pyelitis. Since pyelitis and ureteritis are common complications of pregnancy, a catheter sample of urine must be examined for the presence of pus cells. In pyelitis there is a sharp rise in temperature accompanied by a 'chilly' feeling, yet the patient does not appear to be acutely ill.

Red degeneration of a fibromyoma situated on the right side is likely to cause confusion, especially in the first trimester. The acute pain, rise of temperature, nausea and tenderness on the right side closely simulate appendicitis. When a vaginal examination is made, the tender growth on the right side of the uterus will make the diagnosis apparent.

Ruptured ectopic pregnancy on the right side is likely to be mistaken for appendicitis, but clinical features of internal haemorrhage soon develop and indicate the diagnosis.

Twisted Ovarian Cyst. The clinical picture of acute appendicitis is sometimes closely simulated by a twisted ovarian cyst. The diagnosis becomes evident when the cyst is palpated either abdominally or vaginally.

Treatment. Prompt surgical treatment is necessary as the risk in waiting is great. The abdomen should be opened by a right paramedian incision. The operation is not difficult in the first three months of pregnancy, but after that, the presence of a gravid uterus and the upward displacement of the appendix makes the operation difficult. As far as possible, the appendix should be removed. If there is an abscess, a stab wound might be made in the flank and

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drainage established through it.

An abortion or an onset of premature labour following operation is likely. In the past, the sudden reduction in the size of the uterus after abortion frequently caused spread of the localised infection. Also, serious puerperal sepsis occurred in many of them. Nowadays, with the free use of antibiotics, these dangers have been considerably reduced.

Rupture of Liver

Rupture of the liver is a rare but a grave complication. Howard and Fondrich collected 14 cases of rupture of the liver during pregnancy. Eight of them died following operation.

Rupture may be spontaneous or traumatic. In most of the reported cases, rupture occurred in multiparae during the last trimester, associated with hypertensive toxæmia of pregnancy. The probable etiology in the hypertensive cases was subcapsular haemorrhage which progressed to rupture.

It is seldom possible to correctly diagnose rupture of the liver pre-operatively, but massive intraperitoneal haemorrhage in a toxæmic patient during the last trimester should suggest a possibility of rupture of the liver.

Treatment consists of suturing, packing with haemostatic agents, or electrocoagulation of the ruptured area.

Motashaw and Deshpande reported a case of rupture of the liver from N.W.M. Hospital, in which sudden severe epigastric pain with signs of internal haemorrhage occurred. The patient died within a few hours, and at post mortem subcapsular haemorrhage was found.

Rupture of Spleen

Rupture of the spleen is a serious complication as it causes massive intraperitoneal haemorrhage. King and Wigley reported 25 cases of spontaneous rupture during pregnancy. An enlarged spleen is more likely to rupture following an injury.

Diagnosis is made after opening the abdomen. When the pregnancy has advanced to near term, a caesarean section is first performed, as then the approach to the spleen is easy.

Hernia

Inguinal Hernia. During pregnancy, an inguinal or a femoral hernia is seldom apparent as the enlarging uterus pushes the con-

nts of the sac away from the hernial ring, unless the intestines are adherent to the sac. Strangulation is, therefore, a rare complication.

Umbilical Hernia. During pregnancy, an umbilical hernia remains unaffected as the enlarging uterus displaces the omentum and the intestines upwards. The umbilical region becomes more prominent on straining because of increased intra-abdominal pressure.

Diaphragmatic Hernia

Herniation through a congenital or acquired defect in the diaphragm occurs relatively infrequently. Hiatus hernia is a special form of diaphragmatic hernia in which herniation occurs through the natural oesophageal opening of the diaphragm.

Herniation of the stomach occurs mostly in the last trimester of pregnancy. Hernia usually disappears after delivery.

The incidence of hiatus hernia occurring during pregnancy is greater in multiparae than in primigravidae. In Mixon and Woloshin's series, 74 per cent of the hernias were found in multiparae. Due to its greater frequency in multiparae, it is more common in older pregnant women.

A fairly typical symptom complex of hiatus hernia during pregnancy is heartburn. Nausea and vomiting even during the later half of pregnancy persist.

Strangulation may occur during pregnancy but it is more likely during, or soon after, labour consequent to forcible expulsive efforts.

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CHAPTER 2

PREGNANCY AND DIABETES MELLITUS

Before the discovery of insulin, pregnancy rarely occurred in diabetic women. In the pre-insulin era, the incidence of pregnancy in diabetic women was 2.5 per cent. The maternal and foetal mortalities were very high amongst the few diabetic women who conceived. With proper control of diabetes during pregnancy, the maternal mortality has been considerably lowered. Peel and Oakley reported at the 12th British Congress of Obstetrics and Gynaecology, 1949, a very low figure of 2 deaths in 141 cases. The foetal mortality has not been correspondingly reduced.

The association of diabetes carries an additional risk to the mother and a much greater risk to the foetus. It is therefore important to test the urine for sugar at least twice, that is at the 24th and 36th weeks of pregnancy. As untreated diabetes frequently produces infertility, many cases of diabetic women come under observation before conception. It should be stressed that as a mild metabolic disorder, a pre-diabetic state can exist for many years before true diabetes is clinically manifested. A pre-diabetic state does not hinder fertility, but its presence is indicated when there is a previous obstetric history of birth of over-weight live babies or birth of large macerated foetuses. Due to close liaison between the physician and the obstetrician the outlook for a successful pregnancy has improved considerably.

The alterations in the carbohydrate metabolism during pregnancy has been described on page 63.

Investigation of Glycosuria

The presence of glycosuria in pregnant women should be investigated by repeated estimations of capillary blood sugar and by a glucose tolerance test. Glycosuria, during pregnancy, may be (1) physiological or alimentary glycosuria (oxyhyperglycaemia), (2) due to fall in the renal threshold for glucose (orthoglycaemic glycosuria), and (3) as a result of impaired glucose tolerance (diabetes mellitus).

Samples of capillary blood and urine are taken in the fasting state, followed by ingestion of 100 gm. of glucose in 100 ml. of

water. Blood and urine are collected at intervals of half hour for 2½ hours.

Alimentary Glycosuria. In this condition, there is rapid absorption of carbohydrates from the gut. As a result, blood sugar levels are temporarily raised beyond the renal threshold until storage mechanism and insulin step in. Glucose tolerance presents a lag curve in which there is a rapid rise of blood sugar even up to 200 mg. per 100 ml., but it returns to normal within two hours. Doubts are raised as to whether alimentary glycosuria ever exists clinically.

In *renal glycosuria*, blood sugar does not rise to the normal, 180 mg. per 100 ml., and returns to 100 mg. per 100 ml. within 2 hours.

A true diabetic curve is when the blood sugar rises above 200 mg. per 100 ml. and does not return to normal after 2 or even 2½ hours.

Lawrence concludes that, if the fasting blood sugar is below 120 mg. per 100 ml. and has returned to this figure within 2 hours after 100 gm. of glucose, the case can be classified with confidence as non-diabetic, irrespective of the intervening hyperglycaemia and the accompanying glycosuria.

Complications

Toxaemia of Pregnancy. The incidence of toxaemia of pregnancy is the greatest in the last three or four weeks of pregnancy and is an important consideration in favour of termination of pregnancy at the 36th week. The incidence of toxaemia in series of cases which have delivered at term is 20 to 40 per cent. Peel in 1955 gave the average incidence of toxaemia as 20 per cent.

Hydramnios. The tendency to formation of excess liquor in diabetic pregnancies is well known. Peel, 1955, gives an incidence of gross hydramnios as 25 per cent. Barnes and Morgan, 1949, an incidence of 29 per cent; Stevenson an incidence of 31 per cent. The presence of this complication is generally regarded as having poor prognosis for the foetus, especially if toxaemia is also present.

Excessive Foetal Development. The birth of large babies to diabetic women is characteristic. The excessive birth weight is partly due to acceleration of foetal skeletal growth by the increased production of growth hormone by the anterior pituitary gland and partly due to excessive deposition of fat in subcutaneous tissue.

Water retention in the tissues also contributes towards excessive weight.

Foetal Malformations. The incidence of foetal malformations is high, 6 per cent, in diabetic pregnancies as compared to less than 1 per cent in normal pregnancies. Stevenson, 1956, gives an incidence of 5.8 per cent.

Fate of Foetus. The high perinatal mortality among the diabetic women is due to many factors. *Intrauterine death* in the last four weeks of pregnancy is a well known feature and is an important reason for terminating pregnancy at the 36th week.

Serious congenital abnormalities accounted for 14 per cent of foetal deaths in the series analysed by White.

These excessively large babies stand labour badly and a prolonged labour is an important contributory cause towards foetal death as a result of cerebral injury during vaginal delivery.

Ketosis during pregnancy which is not easily controlled is likely to cause death in utero.

The foetal survival rate is low in maternal diabetes of long standing with retinal and renal cardiovascular changes.

Foetal hypoglycaemia after birth is likely because maternal hyperglycaemia during pregnancy leads to foetal hyperinsulinism. Normal blood sugar in the newborn on the first day is 40-50 mg. per cent. In the newborn babies of diabetics it is often as low as 25 mg. per cent. In the early neonatal period, attacks of cyanosis and respiratory embarrassment cause foetal death.

The finding of atelectasis, *hyaline membrane*, at autopsy has been observed and is also a contributory cause of foetal death.

Classification. White's classification of maternal diabetes is useful for the management of diabetes during pregnancy.

Class A. Diagnosis of diabetes is made on glucose tolerance test which deviates slightly from normal. Diabetes can be controlled by dietetic regulations and insulin therapy is not required. Foetal salvage is about 90 per cent.

Class B. Includes cases of onset of diabetes at the age of 20; or those in whom the duration of disease is less than 10 years; and those who have no evidence of vascular disease.

Class C. Those in whom the onset of diabetes occurred between the ages of 10 and 19 years; or duration of diabetes is between 10 and 19 years and those who have minimal or no evidence of vascular disease.

Class D. Onset of diabetes under 10 years, or duration is of 20 years or more, and those having evidence of vascular disease, such as retinitis, calcification of arteries of the legs, or transitory hypertension.

Class E. Those in whom calcification of pelvic arteries is seen by X-ray.

Class F. All patients with vascular nephritis. Intercapillary glomerulosclerosis, the specific renal disease of diabetes mellitus—Kimmelstiel-Wilson's disease.

Management. The management of each case is an individual problem and a close cooperation between the obstetrician and the physician is essential for the successful conduction of pregnancy and labour. It is frequently necessary to admit these cases at intervals for regular check-up in order to maintain a satisfactory control of the diabetic state.

The use of stilboestrol and progesterone was recommended by White but, they have not been found particularly useful in lowering perinatal mortality and, at the present time, sex hormones are rarely given.

The diet is calculated by multiplying the weight of the patient in pounds by 10. About 200 calories are added in young women. Thus, a patient weighing 120 pounds requires basal calories $120 \times 10 = 1200 + 200 = 1400$. Fifty per cent of basal calories are added for moderate activity. The total daily caloric value is, therefore, $1400 + 700 = 2100$. Another way of calculating the caloric value requirements is to multiply the weight in kilograms by 30 (120 lbs. $= 72 \text{ kg.} \times 30 = 2160$).

Daily protein intake should not be less than 2 gm. per kg. Minimum 200 gm. carbohydrates should be given daily. It is better to restrict sodium intake.

Insulin is the main treatment for diabetes. Plain insulin is usually used but it is often combined with NPH (long acting) insulin.

Termination of Pregnancy. There is no general agreement regarding interruption of pregnancy at the 36th week or regarding the mode of delivery. Mild cases of Class A should be allowed to go into labour spontaneously and 90 per cent foetal survival can be expected. In many clinics, cases of Classes B to E are terminated at the 36th week for fear of onset of maternal complications like toxæmia and hydramnios during the last four weeks and for the unpredictable intrauterine death of the foetus. The size of the foetus

is estimated by palpation and by X-ray evidence of the presence of distal femoral epiphyses. Radiograph will also show a halo indicating foetal oedema and impending intrauterine death.

The mode of delivery also varies in different clinics and many factors have to be taken into consideration before deciding upon induction of labour by the artificial rupture of the membranes or delivery by caesarean section.

Labour. Prolonged labour should be avoided and hence trial of labour is better not undertaken. During labour, poor carbohydrate intake, vomiting and dehydration should be guarded against as hypoglycaemia and ketosis are real dangers of prolonged labour. Therefore, patient should be given frequent glucose feeds with smaller doses of insulin at intervals of 4-6 hours. Control of diabetes becomes more and more difficult as duration of labour increases beyond 24 hours.

Induction of labour by rupture of the membranes is indicated in multiparae with previous live births when the foetus is not too large and the head is well engaged. Should the onset of labour be delayed for more than 12 hours, or the progress of labour is slow or if foetal distress occur, an immediate caesarean section is performed.

Caesarean section is considered by many as the method of choice in terminating a diabetic pregnancy because the babies are usually large and tolerate labour badly.

Puerperium. After delivery, the insulin requirements are much reduced and unless the insulin dosage is readjusted hypoglycaemia may develop. Infection during puerperium should be promptly treated.

Care of Newborn Baby

There is considerable loss of weight during the first few days due to elimination of water from the subcutaneous oedema. It is therefore advisable not to give fluids and not to start feeds for the first three days until oedema has disappeared.

Though these infants weigh 10 pounds or more, most of them have been delivered prematurely and should be managed as premature infants. Frequently, there is large amount of fluid in the stomach of babies of diabetic mothers and emptying of the stomach soon after birth is advisable. The air-passages should also be kept

clear by posture and by aspiration of pharynx. Lung complications are common in these babies.

Hypoglycaemia in the newborn is avoided by giving 10 ml. of 50% solution of glucose by mouth, or by injection of 5 ml. of a 10% solution every two hours. The risk of hypoglycaemia seems to be less in the light of recent studies on foetal blood sugar, but hyaline membrane is often present.

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CHAPTER 3

ANAEMIA IN PREGNANCY

Anaemia during pregnancy is a major obstetric problem, particularly in India, where the nutritional standard is poor in a majority of the low income group. The gravity of the problem is apparent from the maternal mortality figures. The maternal deaths of the last 30 years, 1931-1960, at the N.W.M. Hospital, have been analysed in a Paper presented at the International Conference of Obstetrics and Gynaecology (Asiatic Section) held at Calcutta in 1962. These figures show that anaemia is the largest cause of maternal deaths, claiming 20-25% of the total maternal mortality.

Physiological Haematologic Variations in Pregnancy. There is a gradual increase in the blood volume from the second or the third month of pregnancy, and by the end of the sixth month, an increase of about 25 per cent occurs. This increase is mainly due to an increase in the plasma volume. The plasma is greatest at the end of 32nd week, with a slight decrease during the eighth and the ninth months. It returns to pre-gestational level by the eighth week after delivery. The red and the white blood corpuscles also increase but to a lesser extent as compared with the increase in the plasma volume.

The reduction in haemoglobin which occurs during normal pregnancy is not accompanied by microcytosis and anisocytosis, and the serum iron is not reduced. Therefore, the presence of anisocytosis, microcytosis and the considerable reduction in serum iron, differentiate physiological lowering of haemoglobin values in normal pregnancy from anaemia.

The increase in blood volume is purposeful, and has several advantages. As a result of haemodilution, the loss of haemoglobin resulting from the inevitable loss of blood during parturition is reduced. The haemodilution, by reducing the viscosity of the blood, diminishes the peripheral resistance and increases the rate of the flow of blood through the placenta.

A mild leucocytosis during pregnancy is due to an increase in the non-segmented and segmented neutrophils.

The bone marrow is hyperplastic during the latter half of pregnancy. There is an increase in granulopoiesis, erythropoiesis and

reticulocytes. Many workers have shown that if the bone marrow is supplemented with sufficient amounts of iron, folic acid, vitamin C and essential amino acids, it will respond by producing adequate amounts of red cells and haemoglobin in proportion to the increase in the plasma volume.

From the sixth month there is an increase in the erythrocyte sedimentation rates, probably due to an increase in the plasma proteins, particularly fibrinogen.

Due to haemodilution, the haemoglobin may fall to 10 gm. per 100 ml. (14.5 gm. equal to 100 per cent Hb). In India, due to poor nutritional standards, a fall upto 9 gm. per 100 ml., i.e. 62 per cent, should be considered as the normal limit of haemoglobin during pregnancy.

These physiological changes in the blood are reversible, and normal limits are reached within six weeks after delivery.

Iron Metabolism. This has been described on page 65.

Laboratory Findings. Wintrobe has pointed out that differentiation of the anaemias is made easy by calculation of the volume and haemoglobin content of the red blood cells. For calculation of these indices, the normal (100 per cent) red blood cell count is taken as five million per cubic millimetre and the haemoglobin as 14.5 gm. per 100 cubic centimetres.

The haematocrit or packed cell volume for men ranges from 40 c.c. to 54 c.c. per 100 c.c. of blood, with an average of 47 c.c. For women, the range is from 37 c.c. to 47 c.c., with an average of 42 c.c.

With the following data, the number of red blood cells, grams of haemoglobin per 100 c.c. of blood, and haematocrit value, indices of help in differential diagnosis can be calculated. Average normal values given below are taken from Wintrobe.

- (1) Colour Index $\frac{\text{Haemoglobin per cent}}{\text{R.B.C. per cent}}$
- (2) Haematocrit (P.C.V.): Male average, 47 c.c., and female average, 42 c.c. per 100 c.c. of blood.
- (3) Mean corpuscular volume (M.C.V.) $\frac{\text{Haematocrit \%} \times 10}{\text{R.B.C. in millions}}$
(Average 87 cu. microns).
- (4) Mean corpuscular haemoglobin (M.C.H.) $\frac{\text{Gm. Hb. per 100 c.c.} \times 10}{\text{R.B.C. in millions}}$

(Average 27.5 micromicrograms).

(5) Mean corpuscular haemoglobin concentrate (M.C.H.C.)

$\frac{\text{Gm. Hb. per 100 c.c.} \times 10}{\text{Haematocrit per cent}}$

(Average 35 per cent).

Bone Marrow Study. In India, where anaemia is so prevalent, it is not possible to do bone marrow study in every case. However, in all cases where Hb is less than 7 gm. per cent, or the R.B.C. count is 2.5 millions or less, bone marrow study is desirable before instituting treatment. Again, when anaemia above these levels fails to respond to usual iron therapy, bone marrow study might help in deciding the correct line of treatment.

Etiological Factors. In women, there is cyclic loss of blood due to menstruation. It has been estimated that on an average 80-100 c.c. of blood loss occurs during menstruation, and should there be menorrhagia the loss would be still greater. Therefore, a loss of 40-50 mg. of iron occurs at each menstrual period, and unless this loss is compensated by a daily dietary intake of 20-40 mg. of iron, hypochromic microcytic iron deficiency anaemia sets in.

In India, as a result of malnutrition, anaemia frequently commences during childhood, so that when puberty is reached and menstruation starts, the already existing anaemia is worsened. Early marriages are common in India, and it is not at all uncommon to observe young primigravidae, below the age of 20, suffering from iron deficiency anaemia. Shirali and Bhatt reviewed 2,000 primigravidae admitted to the N.W.M. Hospital, and found half of them having about 50 per cent haemoglobin level. It is evident how severe the anaemia becomes in many of them when pregnancies follow in rapid succession.

The physiological haemodilution during pregnancy reduces the haemoglobin percentage and the red cell count, and the previous non-pregnant anaemic condition becomes clinically more evident.

The iron store is further depleted during pregnancy by vomiting, poor or capricious appetite, gastric intolerance to iron, and the foetal requirements of iron.

It has been estimated that 725 mg. of iron is needed during pregnancy, 400 mg. for the foetal needs, 100 mg. for the placenta, 50 mg. for the uterus, and 175 mg. for the normal blood loss during childbirth. Further, about 180 mg. of iron are lost during a six month period of lactation. Due to amenorrhoea during preg-

nancy, there is some conservation of iron (average menstrual loss is 25 to 50 mg.), but even after accounting for that, there is a deficit of about 400 mg. during pregnancy.

Most of the amino acids take part in the formation of the haemoglobin molecule, especially lucine and methionine. Adequate amounts of vitamin C are also necessary for synthesis of haemoglobin. As a result of malnutrition, the plasma proteins are reduced with low albumin and high gamma-globulin values.

It is therefore evident that nutritional anaemia is a national problem and, unless nutritional standards are improved, the gravity of anaemia during pregnancy will remain, irrespective of improvements in therapy.

Nutritional Anaemia with Normoblastic Bone Marrow

Clinical Features. The clinical features of iron deficiency is the commonest cause of anaemia during pregnancy. Dietetic protein deficiency is an important contributory cause. The diet of Indian women is poor in proteins but probably richer in iron than the diet of women in Western countries. Many of them are vegetarians and the chief source of proteins for them is milk and pulses. Milk is so expensive that very few can afford to take it in sufficient quantities, and their only source of proteins is pulses.

As a result of dietary deficiency of proteins, the quantity of plasma proteins is lowered, and transport of iron for storage and synthesis of haemoglobin suffers.

Clinical Features. The clinical features of iron deficiency anaemia during pregnancy depend on the severity of anaemia. Mild and moderate degrees of anaemia may be asymptomatic, and routine examination of blood during pregnancy reveals the anaemic state. Anaemia usually becomes manifest after the 24th week of pregnancy due to the increased demands of iron for the developing foetus. Those in whom symptoms of anaemia occur early in pregnancy are more serious, as with the progress of pregnancy the anaemia is worsened.

General Appearance. In moderate degree of anaemia, pallor of the conjunctivae, the tongue and the nails is apparent. In long standing anaemia, the nails are spoon-shaped (koilonychia). In severe anaemia, the sallow skin, oedematous face, and oedema of the legs give a characteristic appearance. Lassitude and spells of giddiness are common complaints.

Gastro-intestinal Symptoms. Glossitis and dyspepsia due to the deficiency of hydrochloric acid are frequently present. Some may suffer from attacks of diarrhoea.

Cardio-vascular Symptoms. Slight dyspnoea on exertion is present, in many cases; but severe dyspnoea is a grave symptom, and is associated with severe anaemia. The heart is slightly dilated, and at the apex and pulmonary areas, there is a soft systolic murmur which is heard in the lying down position and is faint or absent on sitting up. The blood pressure is low unless there is associated toxæmia.

Premature labour is common. Not infrequently, premature labour occurs following a blood transfusion or intravenous iron therapy. The labour is usually quick. The third stage of labour should be conducted with great care, because even a small bout of post partum bleeding may not be tolerated by a severely anaemic woman.

Many of the severe cases die from sudden circulatory failure within the first twenty hours after confinement, or during the first week of the puerperium.

Laboratory Findings. Making allowances for haemodilution, the average normal standard for pregnant women in India is taken as haemoglobin, 9 gm. per 100 ml. (14.5 gm. is equal to 100 per cent) and the red cells 3-3.5 millions per c.mm.; values below these figures are considered as anaemic.

In moderate anaemia, the haemoglobin is between 7 and 9 gm. (50-65 per cent), and the red cells 2.5 to 3 millions per c.mm. In severe anaemias, the haemoglobin value is as low as 3 to 5 gm. (20-35 per cent) and the red cell count is 1 to 2.5 millions. The colour index is below 1, and may be as low as 0.8 in severe cases. Due to deficiency of iron, the formation of red blood corpuscles is disturbed. The size and shape of the R.B.C. are considerably altered. Varying degrees of anisocytosis, poikilocytosis, microcytosis and hypochromia are present in the peripheral smears.

As a result of the decrease in haemoglobin and the smaller size of the red cells, the mean corpuscular volume (MCV) is low, while the mean corpuscular haemoglobin (MCH) and the mean corpuscular haemoglobin concentration (MCHC) are much lower.

The leucocytes and the platelets are normal in number, size and morphology.

Bone Marrow. The bone marrow shows normoblastic hyper-

plasia, normoblasts forming more than 50 per cent of the nucleated cells.

Biochemical Changes. The serum iron is greatly reduced, and the iron-binding capacity is increased in iron deficiency anaemias.

Treatment. Cases of severe anaemia having 40% or less of haemoglobin must be hospitalised until the haemoglobin is raised above 50 per cent. Severely anaemic patients must be kept at complete rest, and a nutritious diet rich in animal proteins and vitamins given. As most of the lower income group of patients are vegetarians, the chief source of proteins for them is milk and pulses.

Oral Iron Therapy. Indications. (1) When the haemoglobin percentage is not less than 50, oral iron therapy is successful. (2) A more severe degree of anaemia (Hb, 40-50%) improves with oral iron therapy, provided the treatment is started from the early months of pregnancy. (3) As a small prophylactic dose throughout pregnancy in all pregnant women. (4) Maintenance therapy after a successful parenteral therapy.

It does not matter what preparation of iron is prescribed, but for ready absorption from the digestive tract, a ferrous salt is preferable. There are many ferrous salts available, but simple ferrous sulphate should be the choice, unless there is severe gastric intolerance to it. Other commonly prescribed ferrous preparations are: ferrous gluconate, ferrous fumarate and ferrous carbonate. Ferri et ammonium citrate was previously a very popular preparation and was given in large doses, 45-60 gr. (3-4 gm.) three times a day, but is seldom used now because it has to be given as a mixture which has the disadvantage of staining the teeth, the gums, and the tongue. The dose of ferrous sulphate is 5-6 gr. (0.2-0.4 gm.) three times a day, of ferrous carbonate 15 gr. (1 gm.) three times a day. Ferrous gluconate and ferrous fumarate are sometimes preferred, because they are less likely to cause gastro-intestinal symptoms.

Large doses of iron should be prescribed because only a small quantity is absorbed from the digestive tract. The limiting factor for oral iron therapy is gastro-intestinal upset, such as nausea, vomiting, diarrhoea, constipation or abdominal colic. To make the patient tolerate a large dose, treatment should be started with half of the maximum dose and gradually increased to the maximum. Oral iron preparations must be given after meals.

Iron therapy is considered effective when there is definite reticulocyte response in a few days, and repeated estimations show rise of haemoglobin, about 0.15 gm. per 100 ml. or 1 per cent per

day. If there is failure to obtain a satisfactory response in two or three weeks, it is advisable to estimate the serum iron. When absorption from the gastro-intestinal tract is at fault, the serum iron will be still low; but when there is some fault in the utilisation of the absorbed iron, the serum iron will be normal or raised. When absorption is low, the administration of dilute hydrochloric acid in doses of $\frac{1}{2}$ to 1 dr. with the principal meals is useful.

Ascorbic acid should be combined with oral iron therapy because it aids absorption of iron from the digestive tract by virtue of its reducing action.

Parenteral Iron Therapy. Indications for intravenous or intramuscular iron therapy are: (1) Severe hypochromic anaemia found during the later months of pregnancy; (2) gastric intolerance to iron; (3) iron is not absorbed for some reason from the alimentary tract.

Intravenous Therapy. Saccharated iron oxide preparation is used. Most of the intravenous preparations are supplied in sterile ampoules containing 100 mg. of elemental iron in 5 ml.

The total iron dosage required can be calculated as 25 mg. elemental iron for raising 1 per cent haemoglobin.

Methods of Administration. The first dose is a test dose of 2 c.c. (40 mg.) of iron and, if the patient is not sensitive, the subsequent ones are of 5 c.c. The dose to be given is drawn into a 20 ml. syringe. The needle used for aspiration is changed to avoid any contamination around the vein by the iron adherent to the outside of the needle. After inserting the needle into the vein, about 10 ml. of blood are withdrawn into the syringe to dilute the iron preparation, and then the whole is injected very slowly at the rate of 1 ml. per 20 seconds. Any leakage outside the vein causes severe pain and inflammation of the surrounding tissues. The treatment is continued as daily injections of 5 to 10 c.c. (100-200 mg.) of iron.

Those patients who are sensitive have slight flushing, palpitation, a constrictive sensation in the chest, dyspnoea and lumbar backache.

Intravenous Infusion Therapy. Instead of repeated small intravenous doses, iron can be given in massive doses by diluting 500 mg. elemental iron in 500 c.c. of 5 per cent dextrose solution. Sequeira and Parikh have reported satisfactory results in cases treated at the N.W.M. Hospital.

To minimise the possible allergic reactions, an antihistaminic

and antiallergic preparation is added to the infusion. The drip is run in at the rate of 45 to 60 drops per minute, and it requires about 3-4 hours to administer the drip. A second drip containing the same or a larger dose is given 72 hours later, and it may be even necessary to give a third infusion.

Instead of two or three drips of 500 mg., a single massive drip containing 1,000 mgm. of iron in 1,000 c.c. of 5% glucose solution has been given at the N.W.M. Hospital by Parikh et al and this has given equally good results.

Safety of Infusion Therapy. If a patient is not sensitive to the test dose, intravenous iron infusions give no reactions except for the usual pyrogenic reactions associated with any intravenous fluid infusions. The reactions following intravenous use of saccharated iron oxide are due to precipitation of an inherently unstable compound. The pH of all intravenous iron preparations is very high (about 9.5) as compared to that of blood. The incidence of reactions increases with the rapidity of the administration of the injections. The drip method is the slowest and therefore gives rise to least reactions. The objection to the deposit of iron in the tissues causing chronic toxic effects is not substantiated in clinical practice.

Efficacy of Intravenous Therapy. Infusion iron therapy can be considered adequate if the daily haemoglobin increment is 1%. Sequeira and Parikh in a series of 23 cases treated at the N.W.M. Hospital achieved a daily average haemoglobin increment of 1.4% or 0.2 gm. per 100 c.c. of blood. Govan reports an average increase in haemoglobin by 1.2 gm. per 100 c.c. of blood in the first week, and 1.0 gm. in the second week of intravenous therapy.

Intramuscular Therapy. Intramuscular iron therapy is easy to administer and can be used by nurses in rural areas. Its great disadvantage is the dark brown staining of the skin in some cases after several injections have been given. Besides, intramuscular preparations are much costlier than intravenous ones.

Preparations for intramuscular administration are complexes of ferric hydroxide, and low molecular weight iron dextrose. They are available in 2 ml. and 5 ml. ampoules containing 50 mg. of elemental iron per ml. The injections are preferably given deep into the outer and upper quadrant of the gluteal region. To diminish pain and the brown staining of the superficial tissues, it is necessary to use two different needles, one for drawing the contents of

the ampoule into the syringe, and the other, a long 6 cm. needle, for intramuscular injection.

The response to intramuscular iron therapy is almost as satisfactory as that obtained by the intravenous route. Scott and Govan report an average increase in haemoglobin of 0.77 gm. per 100 c.c. of blood in the first week, of 0.94 gm. in the second week, and of 0.62 gm. in the third week.

Hypochromic Anaemia in Ankylostomiasis

Hookworm infection is widely prevalent in India. Heavy infestations have been found in the South, Madhya Pradesh, Assam, West Bengal and Bihar. The States of Maharashtra, the Punjab and Mysore are free from hookworm infestation.

The infection is acquired from contaminated drinking water or by burrowing larvae through the skin of the feet. Prophylaxis, therefore, consists in avoiding contamination of the drinking water, and the proper disposal of the excreta.

Anaemia is the chief feature of this disease, and is due to mechanical loss of blood. The mouth of the worm attaches itself to the villi in the small intestines, and by suction and lysis, causes superficial erosion of the mucosa. Numerous capillaries and venules are opened up from which extravasation of blood occurs. From time to time, the worm abandons unprofitable sites and attaches itself to new places. Oozing continues from the abandoned sites.

Clinical Features. It is a chronic disease and the signs and symptoms are of iron deficiency anaemia. The bone marrow is both hyperplastic and normoblastic. If improvement occurs soon after deworming by anthelmintics, then it is proved that the cause of anaemia is due to blood loss and that there is no failure of absorption of iron from the digestive tract due to mucosal erosion.

Recently, a dimorphic blood picture has been observed in many cases and it is presumably due to associated deficiency of anti-megaloblastic factor (AMF) on account of low intake of a protein diet. Examination of stool diagnoses the disease by showing hookworm ova. The degree of infestation is established by a quantitative estimation of the number of ova per gram of stool.

Treatment. As recommended by Napier, Das Gupta and Majumdar a combined treatment of anaemia by iron alone or, when the anaemia is diamorphic, by iron, liver extract and folic acid, along with one or more courses of anthelmintic, should be given.

To start with, anaemia is treated until the haemoglobin rises to 10 gm. per 100 ml. After improving the clinical state, a course of anthelmintics is given. The effective anthelmintics are, tetrachlorethylene, dose 3 c.c.; oil of chenopodium, dose 1 ml.; hexylresorcinol, dose 1 gm. in capsule; cashew nut shell extract, dose 6 gm. A saline purgative is given along with tetrachlorethylene, and two hours after the administration of oil of chenopodium and cashew nut extract. A purgative is not required when the treatment is with hexylresorcinol. The saline purgative is repeated if there is no evacuation within two hours.

Nutritional Anaemia with Dimorphic Bone Marrow (Dimorphic Anaemia)

Though iron deficiency anaemia (microcytic hypochromic anaemia) is the commonest, a dual deficiency of iron and antimegaloblastic factor may coexist. The term 'dimorphic anaemia', suggested by Trowell in 1942, defines the mixed hypochromic and megaloblastic blood picture and bone marrow response. With the increasing deficiency of the essential elements of food, 'dimorphic anaemia' is on the increase all over India.

For proper haematopoiesis, nucleic acid and nucleoprotein synthesis are necessary. Vitamin B₁₂, folic acid and ascorbic acid in adequate amounts are necessary for nucleic acid synthesis, and deficiency of these essentials, results in megaloblastic anaemia.

Pathogenesis. Dimorphic anaemia may be produced by dietary inadequacy, or by deficient intake, as in nausea and vomiting of pregnancy, or a deficient absorption of both iron and the antimegaloblastic factor.

The type of blood picture and bone marrow response varies, depending on the predominance of one factor over the other.

Clinical Features. There is no distinctive clinical picture and the diagnosis is made on finding a macrocytic hypochromic, or macrocytic orthochromic, or normocytic hypochromic blood picture. On an extensive search, normoblasts, intermediate megaloblasts, or megaloblasts, may be found in the peripheral blood smear. Leucopenia is common.

Bone Marrow. The bone marrow is hypercellular. Normoblasts, intermediate megaloblasts, and a few megaloblasts are usually found. Due to associated iron deficiency, megaloblasts with non-haemoglobinised cytoplasm are present. The normoblasts also

show incomplete haemoglobinisation. Abnormal forms of granulocytes will also be present.

Biochemical Findings. There is a reduction of free hydrochloric acid, but a histaminé-fast achlorhydria is rare.

Treatment. A combination of crude liver extract, folic acid and iron gives the best response. Crude liver extract, 2 c.c., intramuscularly with folie acid 10 mg. three times a week, and orally ferrous sulphate 1.2 gm. are given daily. The length of time the treatment has to be continued depends on the response.

Blood transfusion is valuable in these cases.

Aplastic Anaemia Complicating Pregnancy

Aplastic anaemia is a rare disease and it is still rarer during pregnancy. Rornisky could collect only 17 cases in the last 116 years.

It is characterised by persistent anaemia in which there is erythrocytopenia, granulocytopenia, thrombocytopenia and a marked rise in the sedimentation rate. The bone marrow may be acellular, normocellular or hypercellular with absence of immature white and red cells.

The dangers of aplastic anaemia on a pregnant woman are: anaemia, haemorrhage and infection. These cases have to be treated with repeated transfusions of fresh blood.

Treatment of Severe Anaemia By Exchange Transfusion

Irrespective of the etiology, the management of cases of severe anaemia in pregnancy is a formidable problem. Severe anaemia cases are those in which the haemoglobin value is less than 4 g. per cent and the P.C.V. percentage is less than 13. Fullerton and Turner found that when the P.C.V. was less than 13, congestive cardiac failure was present in most of the cases. This condition is more desperate to manage when cases come for treatment at or near full term, and some even in labour or after a home delivery.

The usual recognised forms of treatment are of no use in such cases. Oral iron therapy is, of course, out of the question. Parenteral iron therapy, especially by the intravenous route, is risky in these severe cases with congestive cardiac failure. Simple blood transfusion alone is not applicable because it increases the blood

volume. This frequently proves fatal when the patient is in congestive cardiac failure and, if she is not, failure may be induced by transfusion. Transfusion of packed cells, 150-200 ml., in these severe cases does not materially improve the oxygen-carrying-capacity of the blood, and has not given encouraging results.

It is to overcome these difficulties that Fullerton and Turner transfused 1000-1500 ml. of packed cells by exchange transfusion with encouraging results. Menon, from Madras, has also given trial to exchange transfusion in 50 cases with satisfactory results. Fullerton and Turner gave an exchange transfusion not only at or near term but also to patients in labour and, occasionally, during the second stage.

Procedure. An hour before the transfusion, the patient was given 100 mg. pethidine hydrochloride and an antihistaminic. The anterior tibial vein is used for infusion and cubital vein for venesection. In grossly oedematous patients, there is difficulty in getting suitable veins and venesection with introduction of fine polyethylene tube is necessary. Through the polyethylene tube it is easier to push the blood in and withdraw blood. One hundred ml. of packed cells are drawn from standard transfusion bottles into a 100 ml. all glass syringe having a three way glass stop cock and injected under pressure. Simultaneously, a little more than 100 ml. is withdrawn from the anterior cubital vein. The rate of transfusion is so adjusted as to be a little slower than the withdrawal. Exchange of 1000-1500 ml. is carried out in about 15 to 20 minutes.

Results. The importance of exchange transfusion is readily seen from the results. In Fullerton and Turner's series of 107 cases, the mortality was less than 3 per cent as compared to 20 per cent in cases treated by other methods. In Meoon's series of 50 cases there was 1 death and that too in a primigravida with severe eclampsia.

Also within 48 hours of an exchange transfusion, average increase of haemoglobin level in Menon's series was 2 g. per cent, the maximum rise observed being 3.7 g. per cent and the P.C.V. increased by 6 per cent.

Marked improvement in cases of congestive failure with severe dyspnoea was observed.

No serious reactions were observed except in Fullerton and Turner's series severe jaundice occurred in 4 cases, but they state that as all cases were not followed up for six months, the actual incidence was probably much higher.

In view of the dramatic results, exchange transfusions offer great hope and extensive trials in different hospitals will, in a short time, correctly evaluate the place of this procedure in the management of cases of severe anaemia in pregnancy.

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CHAPTER 4

HEART DISEASE IN PREGNANCY

Organic heart disease is a serious complication in pregnant women. Jenson estimates that every year 1,000 maternal deaths occur in the United States from cardiac disease. With the reduction of maternal deaths from other causes, cardiac disease has become relatively more frequent as a cause of maternal mortality. The treatment of cardiac disease in pregnant women has considerably improved in recent years, largely due to the close cooperation of the cardiologist and the obstetrician in the management of these cases.

Incidence. Forty seven cases of cardiac disease occurred at the N.W.M. Hospital, Bombay, from September 1953 to May 1956. During this period, there were 22,833 full term confinements which give an incidence of 0.2%. At the Guy's Hospital, London, the incidence as given by Louis was 1.3%; in the Boston Lying-in Hospital it was 1.7%. The incidence of cardiac disease in Western countries is probably related to the higher incidence of rheumatic fever in these countries.

Age and Parity. It is generally stated that the percentage of cases of gradually increasing cardiac decompensation rises with age and parity. Rheumatic heart disease mostly occurs during childhood, and there is a latent period of several years before signs of commencing decompensation appear. This, however, does not bear out in this series, and cases of severe decompensation were met with even in first and second paras below the age of 20. The probable reason for such early manifestations of cardiac failure in India are anaemia, economic conditions demanding hard domestic and manual work, early marriages, and repeated pregnancies without adequate spacing. How far parity by itself has adverse effect on cardiac failure, is difficult to say, because with parity, the age of the patient, and with it the duration of cardiac disease, correspondingly increases.

Classification. The classification given by the New York Heart Association is the most acceptable, as it depends upon an estimation of cardiac capacity derived from past history of case and the

present clinical condition, and is not dependent on the presence or the absence of physical signs.

Class 1. Patients with a cardiac disorder, without limitation of physical activity. Ordinary physical activity causes no discomfort.

Class 2. Patients with a cardiac disorder, with slight to moderate limitation of physical activity. Ordinary physical activity causes discomfort. In grade 2, exertional tolerance is slight.

Class 3. Patients with a cardiac disorder, with moderate to great limitation of physical activity. Less than ordinary physical activity causes discomfort. In this grade, exertional tolerance is moderate.

Class 4. Patients with a cardiac disorder, who are unable to carry on any physical activity without discomfort. In this grade, symptoms persist even at rest in bed.

Physiological Changes in Circulatory System During Pregnancy

Some of these changes are caused by the growing uterus altering the mechanics of aspiration of venous blood into the thorax, oxygenation in the lung, and the cardiac output. The movements of the diaphragm normally help the aspiration of venous blood into the thorax, but the raised intra-abdominal pressure during pregnancy, pushes the diaphragm upwards, and impairs its range of movement.

The increased metabolism during pregnancy increases the demand for oxygen, but the impairment of movements of the diaphragm reduces the respiratory efficiency, and this increases the circulatory load. Elevation of the diaphragm alters the position of the heart. The apex is pushed upwards and outwards, and the heart comes to lie more in a transverse axis.

The work done by the heart is generally expressed as the product of the cardiac output and the peripheral resistance. It is definitely established that there is an increase in blood volume during pregnancy. Increase in the plasma volume accounts for the increase in the blood volume. This increase in plasma volume is mostly due to the retention of salt and water in the tissues during pregnancy, causing haemodilution. Palmer and Walker investigated 88 normal women by cardiac catheterization, and found a considerable increase in volume which persisted until the eighth month, and a return towards the normal occurred in the last one

or two months. Hamilton employed the method described by Courmand, and deduced that cardiac output in pregnant women commences to rise during the tenth to the thirteenth week of pregnancy, and reaches a maximum from the twenty sixth to the twenty ninth week. The output returns to normal levels during the period of the 38th to 40th week. As the arterial blood pressure remains unchanged during normal pregnancy, there is no alteration in the peripheral resistance, and therefore, the increased work done by the heart is accounted for by the increase in cardiac output.

Dyspnoea on exertion, as a result of increase in total pulmonary ventilation, commonly occurs in normal pregnancy, especially during the latter half. Tachycardia and breathlessness are frequent, and when they occur at night, may simulate an attack of paroxysmal nocturnal dyspnoea. Tachycardia and occasional premature beats give rise to palpitation. Oedema of legs is common in pregnant women, particularly in India, where nutritional deficiencies are so prevalent.

Elevation of the diaphragm displaces the apical impulse outwards and upwards and simulates cardiac enlargement. Due to the hyperdynamic circulatory state, cardiac impulse is forcible. In many pregnant women, a systolic murmur is heard in the apical pulmonary regions. Sometimes, a loud third sound is heard, and that is due to rapid ventricular filling.

Upto the age of 45, the systolic and the diastolic pressures in women are less than in men of a corresponding age. By the time the age of 45 is reached, the pressures have equalized, and thereafter the average pressure readings in women are a few millimetres higher than in men. The explanation for this sex difference is not known, but it is probable that endocrine factors play a part. The rise of pressure at 45 years of age and thereafter coincides with the involutionary change of the menopause.

It has been shown that about the mid-term, the systolic pressure drops by 4-6 mm. below the normal non-pregnant level. Thereafter, as the pregnancy advances, the pressure increases gradually.

Type of Heart Lesion. In 90% of the cases, the cardiac lesion is of a rheumatic origin, and mitral stenosis preponderates over all the other valvular lesions. In 47 cases of cardiac disease at the N.W.M. Hospital, 29 cases, i.e. 61.7%, were of mitral stenosis; 8 cases, 17%, were combined mitral stenosis and mitral regurgitation; 3 cases, 6.4%, were mitral regurgitation; 2 cases, 4.3%, were of mitral

stenosis with aortic regurgitation; and 5 cases, 10.6%, were of congenital heart lesion.

Clinical Diagnosis. All patients in the prenatal clinic who have a history, no matter how vague or questionable, of cardiac disease, cardiac murmur, or arrhythmia, must be referred to a cardiologist for further investigation. For proper evaluation, the history should be carefully recorded, a detailed physical examination carried out, and electrocardiographie and laboratory studies undertaken.

It is extremely difficult to obtain a history of previous rheumatic fever, especially from the hospital class of patients. A history of having suffered from cardiac failure in a previous pregnancy is, sometimes, obtained. In many cases, previous pregnancies or labour have been uneventful, and the cardiac lesion is detected accidentally during routine antenatal examination. In the series of 47 cases at the N.W.M. Hospital, 27 had decompensation in the present pregnancy. Out of these, only 5 had decompensation in a previous pregnancy, while 22 had uneventful previous pregnancies and labours. In 20 cases there was no evidence of cardiac insufficiency, and the lesion was detected during antenatal check up. This clearly explains the importance of careful examination of the cardiovascular system during antenatal examination to diagnose mild cases of class 1 or 2.

On physical examination, the position of the apex beat is located, the cardiac region is palpated for a thrill, cardiac enlargement is assessed, and the presence of a murmur, its situation, character and conduction, is noted. Functional murmurs are usually at the apex or the pulmonary region, and are blowing and high pitched. Organic murmurs are harsh and low pitched, and are often conducted beyond the precordial region. Diastolic murmurs are almost always organic.

Electrocardiogram and X-ray of the chest will distinguish true enlargement of the heart from positional changes produced by the elevation of the diaphragm.

In Class 1, there is usually no enlargement of the heart. In class 2, a slight enlargement of the heart is often detected, while in classes 3 and 4, cardiac enlargement is always present.

Management During Pregnancy and Labour. There is no doubt that pregnancy involves greater risk for cardiac patients than for a normal individual; but with constant supervision throughout pregnancy, labour, and puerperium, the mortality and morbi-

dity can be greatly reduced. In Europe and America, this objective has been successfully achieved. In India, because of the socioeconomic conditions as well as inadequate supervision during pregnancy and labour, particularly in rural areas, pregnancy with cardiac disease still carries great risk. Successful outcome of pregnancy and labour is not the only objective in management, but also maintenance of the functional capacity of the heart, in spite of pregnancy. At the Boston Lying-in Hospital, after the introduction of the Heart Clinic, the mortality fell to 5% between 1925 and 1927, and to 2 to 3% between 1937 and 1939. In MacRae's series, reported in 1953, there was no maternal death. Gilchrist records current mortality rate as 0.4%, fifteen times less than it was 30 years ago. This rewarding result is due to strict medical supervision of cardiac women throughout pregnancy.

Classes 1 and 2 patients, when kept under strict care, go through pregnancy and labour without any disturbance; while those of classes 3 and 4 are unfavourable cases, and need prolonged hospitalization.

Class 1. These patients are symptomless and can be treated throughout pregnancy as out-patients. Maximum rest is advised; besides 9-10 hours rest at night, they must rest in bed for 2 hours in the afternoon.

Physical activity should be strictly limited to as much as can be performed without feeling dyspnoeic, or even tired.

There is no need to restrict the diet. Those who have oedema should be advised to reduce salt intake, and if necessary, chlorothiozide tablets are prescribed.

Anaemia should be corrected, as severe anaemia may precipitate cardiac failure.

The patient must be hospitalized for 2 weeks before term for complete rest.

Class 2. The management is similar to that described for class 1. During pregnancy, cardiac output reaches the maximum at about 28 to 30 weeks. At this time some cases tend to show cardiac decompensation. These patients must be promptly hospitalized, and urged to remain in the hospital until delivery. In class 2 patients, tachycardia frequently occurs, and, besides strict rest, the patient should be digitalised.

Any respiratory infection is promptly controlled by antibiotics, as even trivial infections are likely to initiate cardiac decompensation, and may even lead to subacute bacterial endocarditis.

Classes 3 and 4. These patients should be hospitalized throughout pregnancy, and the marked reduction in maternal deaths in recent years is largely due to absolute bedrest, and strict supervision in the hospital from the time of the first antenatal visit, until some time after delivery.

Normally, there is no need to restrict the diet. In obese patients, a low calorie diet is prescribed to prevent excessive weight gain. In classes 3 and 4, sodium intake is restricted, as excessive sodium and water retention predispose to the development of pulmonary oedema.

Diuretics. Besides oral diuretic therapy by chlorothiazide and hydrochlorothiazide, it is frequently necessary to give mercurial diuretics parenterally. Parenteral injections of mercurial diuretics are given at intervals to all patients who have well marked signs of congestive heart failure, or excessive fluid retention as manifested by marked oedema, or rapid weight gain, despite the oral diuretics.

Digitalis. Whenever there are symptoms or signs of cardiac failure it is necessary to digitalise the patients. Digitalisation should be carried out slowly to avoid nausea and vomiting, but when acute cardiac failure occurs, rapid digitalisation is necessary.

Acute Pulmonary Oedema. The pattern of cardiac failure encountered in pregnant cardiac patients has generally undergone a change during the past 30 years. Congestive cardiac failure now takes a milder form, and is more readily controlled. Acute pulmonary oedema is nowadays a very serious complication and accounts for a large number of deaths. In the two series at the Royal Infirmary, Edinburgh, compared by Gilchrist, it was evident that in the series 1928-47, congestive cardiac failure accounted for 61 per cent of deaths, and acute pulmonary oedema for 13 per cent. In the series 1948-60, deaths from congestive cardiac failure were only 8 per cent, while deaths due to acute pulmonary oedema were 67 per cent.

It has been shown that congestive cardiac failure is most prone to occur in women with enlarged hearts and considerable myocardial damage. By contrast, women who develop acute pulmonary oedema may be otherwise symptomless. Their hearts are usually small and though mitral stenosis is often severe there is no appreciable myocardial damage. Attacks often occur in the latter half of pregnancy and are more common as term approaches.

Prevention of acute pulmonary oedema includes ample hours

of rest and sleep, diuretics to control hydraemia, and digitalis to reduce tachycardia and improve ventricular output. During the attack, morphine is given subcutaneously, digoxin intravenously, and mercurial diuretic intramuscularly. After an attack of acute pulmonary oedema, it is necessary to confine the patient to bed for the remainder of her pregnancy.

Management of Labour. All cardiac patients must be hospitalized at least two weeks before term and kept at rest. Patients of classes 1 and 2, who are symptomless and fully compensated, do not need any medication during this waiting period, but those having symptoms and signs of cardiac failure are unfavourable cases to go through labour, and every effort must be made to overcome the decompensation before the patient goes into labour. Most of the deaths occur in classes 3 and 4, either during, or within a few hours after delivery.

Physiological Changes in Heart and Circulation during Labour. A brief summary of the physiological changes during labour will help in understanding the principles in the management of the cardiac patients: (1) Oxygen consumption is enormously increased during labour, particularly during the second stage, and effects of oxygen debt persist for more than an hour after delivery. (2) The blood pressure, both systolic and diastolic, rises during labour by 10 to 20 mm. of Hg; the systolic rise being more than the diastolic. (3) The venous pressure rises during labour and for a day after delivery due to increased venous return, muscular effort of labour, and closure of the placental circulation. The direct result of this is an increased load on the right side of the heart. (4) The pulse rate rises during contractions and returns to normal some seconds after the termination of the contraction. A persistent increase in the pulse rate, above 110 to 120 per minute, may be the earliest sign of cardiac failure.

Mode of Delivery. It was once believed that labour imposed a burden too heavy for cardiac patients to bear, and elective caesarean section was preferred to vaginal delivery. In recent years, vaginal delivery is preferred by obstetricians for all the four classes of cardiac patients,—caesarean section being reserved for only those who have some other obstetric indication.

Induction of labour at the 36th week was advocated at one time, but is not recommended, as at the 36th week the physiologically increased cardiac output is still high, and labour at this term would still further increase the cardiac load, and may well prove

dangerous to a cardiac patient. Labour following induction is frequently inert as compared to natural labour at term. A secondary consideration is the prematurity of the newborn.

Management of Vaginal Delivery. All cardiac patients, including the fully compensated symptomless patients of classes 1 and 2, must be hospitalized at least 2 weeks before their expected date of delivery. They are clinically evaluated, and those showing evidence of cardiac failure are promptly treated to prepare them to go through the strain of labour with as little risk as possible.

For the symptomless compensated patients of classes 1 and 2, nothing more than salt restriction, or chlorothiazide to reduce oedema, is necessary. Those having signs of cardiac failure, such as dyspnoea, or orthopnoea, pulmonary congestion and tachycardia, need immediate measures to counteract them. Nursing in the Fowler's position, continuous oxygen, sedation by frequent injections of pethidine, rapid digitalisation orally, or, if labour has commenced, by intravenous injection of digoxin, and administration of mercurial diuretics, are necessary. The onset of labour, before cardiac failure has been controlled, carries grave risk of sudden death.

During the first stage of labour, the patient must be sedated by pethidine, in doses compatible with the progress of labour, and the condition of the foetus. Continuous oxygen by a nasal catheter or a well fitting mask should be given. A half-hourly chart of pulse and respiration must be kept. By these measures most patients can safely tide over this stage.

The second stage of labour demands great muscular effort, and should never be allowed to be prolonged. Class 1 and 2 patients go through this stage with ease, and many of them deliver without assistance. Class 3 and 4 patients, who have either signs of failure or are likely to go into failure during muscular effort of the second stage, should be delivered by application of forceps. Many multiparae of these classes have a short second stage of 5 to 10 minutes and deliver without assistance; but all primiparae showing slow progress, are best delivered by forceps. Pudendal block is the anaesthesia of choice for low forceps delivery, but, for a midcavity forceps application, it is advisable to supplement pudendal block with gas and oxygen.

The third stage is conducted in the usual way. With the delivery of the child, there is a fall in the intra-abdominal pressure, and to counteract this sudden alteration of pressure, a sand bag

should be placed on the abdomen above the fundus. A little extra loss of blood at this stage is, at times, beneficial to a cardiac patient, —but this is not to say that post partum haemorrhage should not be promptly treated.

The most critical period for cardiac patients is the first 12 hours after delivery. With the sudden closure of the placental circuit, there is increased blood volume to the right side of the heart, and sudden cardiac failure with development of pulmonary oedema is the cause of death in many cardiac patients.

During the puerperium, adequate rest should be enforced. Puerperal infection carries a great risk in a cardiac patient, in view of the possibility of developing subacute bacterial endocarditis. Therefore antibiotics should be given prophylactically to all cardiac patients for the first ten days of the puerperium.

Valvotomy during Pregnancy. Valvotomy during pregnancy carries a greater risk than when the operation is performed in the non-pregnant state. The question of advisability of performing valvotomy arises only in the earlier months when congestive cardiac failure threatens, or when acute pulmonary oedema is anticipated. Late pregnancy is no time for major surgery. Almost all are agreed that should signs of failure occur during in the first trimester, it is better to terminate the pregnancy by a therapeutic abortion. When pregnancy has advanced beyond 16 weeks, it is preferable to allow the pregnancy to go to term. Termination by an abdominal hysterotomy has as great, or perhaps greater, hazard than vaginal delivery at term.

With recent advances in cardiac surgery, it is no longer necessary to resort to sterilization in cases having cardiac failure and the best hope for the future for them is to have a vaginal termination of the present conception followed later by valvotomy. Uneventful pregnancy is possible after a successful valvotomy.

Coronary Artery Disease. In 1958, Oliver analysed 1,000 consecutive patients suffering from coronary artery disease. Under the age of 35 the ratio was 19 males to 1 female. Therefore, it is not surprising that coronary heart disease is seldom recognised during pregnancy. In 1960, Watson et al collected from the literature only 26 well authenticated cases.

Hypercholesterolaemia is known to be an important factor in the causation of coronary artery disease. During normal pregnancy, the cholesterol level increases considerably, but this bioche-

mical disturbance is temporary and does not predispose to ischaemic heart disease.

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CHAPTER 5

PULMONARY COMPLICATIONS IN PREGNANCY

Tuberculosis

Pulmonary tuberculosis is the commonest and the most important of all the respiratory diseases that may complicate pregnancy. Besides its clinical importance, it presents social and economical problems. Among the underprivileged population of India, particularly in large overcrowded cities, tuberculosis is still widely prevalent. Many of the accepted principles in the management have been considerably modified by the advent of the era of chemotherapy. It would be interesting to recall the old and outmoded concepts aptly summarised by Young: "If a virgin, no marriage; if married, no pregnancy; if pregnancy, no confinement; for the mother, no suckling."

Various investigations in the advanced countries of the West have shown the desirability of routine chest radiography at the first antenatal visit. At the Mt. Sinai Hospital, New York, approximately three out of 100 women showed evidence of pulmonary tuberculosis during antenatal radiological investigations. In England, the incidence is much less, 0.3 to 0.6 per cent. An ideal radiological examination would mean the taking of a full size X-ray film. Financial stringency in India prevents such an ideal, and mass fluoroscopy appears to be an efficient substitute. To minimise the risk of radiation reaching the foetus, adequate shielding below the chest must be employed.

Management of Pregnant Tuberculous Women. *A. Pregnancy with Inactive Healed Focus.* A patient who is known to have an inactive focus for two or more years can safely go through pregnancy without any danger of reactivation of the focus. She should be under constant supervision and an X-ray film should be taken at least twice during her pregnancy. As most of these cases are from the low income group, care must be taken to ensure good nutrition. There is no need for chemotherapy in these cases. In inactive cases, several pregnancies can be allowed provided they are spaced out.

B. Pregnancy with Active Focus. A case that is known to

have an active focus should not be allowed to become pregnant until some time after the disease has been brought under control.

Previous to the era of chemotherapy, bilateral active pulmonary tuberculosis had a grave prognosis; and, when the disease was diagnosed before the completion of the third month, therapeutic abortion was advised. Nowadays, when an active focus is detected early in pregnancy, a full course of antitubercular treatment is given, and completed before term is reached. When the disease is detected in the second trimester, there may not be enough time to complete the chemotherapy course but, even then, in most of the cases, the disease can be brought under control before labour.

Chemotherapy. Strict bed rest enables the active inflammatory process to subside. The three chemotherapeutic drugs used are: streptomycin or dihydrostreptomycin, paraaminosalicylic acid, and isoniazid. When streptomycin is used alone, there is risk of the development of streptomycin-resistant strains, and therefore a combination of paraaminosalicylic acid and streptomycin is given. The two drugs are given for 90 days or even longer as indicated. Streptomycin is given in daily dose of 1 gm. intramuscularly; 12-16 gm. of P.A.S. are given orally in three divided doses. Streptomycin is known to cross the placental barrier, but toxic effects on the foetus have not been observed. In some cases, isoniazid is combined with P.A.S. According to present concepts, anti-tubercular treatment should be continued for 18 months.

Collapse Therapy. Pneumoperitoneum. Formerly, it was believed that a sudden lowering of the diaphragm immediately after labour was harmful, and prophylactic pneumoperitoneum immediately after labour was advocated. Recent work, however, has shown that the rise of diaphragm is seldom more than an inch and this rise does not occur until pregnancy has well advanced. Besides, any vertical diminution of the lung capacity is amply compensated by the increased width of the thoracic cage. Pneumoperitoneum is useful in bilateral basal exudative lesions, with or without cavitation.

Pneumothorax. For satisfactory collapse, pneumonolysis is usually required, as an incomplete collapse gives disappointing results. In suitable cases of unilateral exudative disease it may be usefully employed. It is not desirable to induce artificial pneumothorax when pregnancy has advanced beyond 34 weeks. Pneumothorax is hardly ever indicated in modern times.

Management during Labour. Unless there is some obstetric

complication, labour is allowed to progress normally. In the presence of active lung lesion, it is advisable to shorten the second stage by applying low forceps under pudendal block anaesthesia.

Should it be necessary to perform a caesarean section, local infiltration anaesthesia should be the anaesthesia of choice.

Neonatal Problems. Isolation. Tuberculous infection of the placenta and foetus is so rare that for practical purposes it can be disregarded. Children born of tuberculous mothers are normally developed and healthy. Therefore, a patient who is suffering from active pulmonary disease should have no contact with her newborn child until her disease has been controlled and is non-infectious.

Breast Feeding. Breast feeding by mother is out of the question when the disease is active, but even in an inactive case it is better not to allow breast feeding because, besides the risk of contact infection to the infant, there is a drain on the maternal nutritional reserves.

BCG Vaccine. Infants born of mothers having pulmonary tuberculosis should receive BCG vaccination shortly after birth and, preferably, be isolated in a hospital until tuberculin conversion has occurred, and then return to the family.

If the infant has not been given BCG vaccine and tuberculin test is positive, it is advisable to treat the infant with isoniazid even in the absence of any clinical evidence of tuberculosis.

Therapeutic Abortion. The place of therapeutic abortion is limited as the harmful effects of procuring an abortion may be greater than those of labour. It is indicated when (1) bilateral, extensive, active disease is detected before the pregnancy has advanced to three months, (2) socio-economic conditions of the family warrant it.

Bronchial Asthma

The relationship between bronchial asthma and pregnancy is not constant. In some of the cases there is definite improvement and the attacks may stop during pregnancy to start once again after lactation. This improvement is considered to be either due to the greater activity of adrenals during pregnancy, or due to the increase in plasma histaminase which exerts some protective action against allergy.

In some, there is aggravation of asthma during pregnancy.

Worsening of the symptoms is attributed to increased blood levels of oestrogen, progesterone and androgens. Cases have been recorded where improvement occurred with a male child and worsening with a female child.

Asthma rarely affects pregnancy. The incidence of abortions is not increased. Termination of pregnancy is not necessary, but allergic manifestations are transmitted to the infants.

Treatment. Aminophyllin, ephedrine, antihistamins and other drugs given to non-pregnant asthmatics, can be safely given to pregnant asthmatics.

In very severe and intractable cases, prednisolone can be given in full doses without any danger, particularly during the last two trimesters.

Respiratory depressant drugs, like pethidine and pentothal, so freely used during labour, should be avoided in asthmatic subjects.

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CHAPTER 6

URINARY COMPLICATIONS ASSOCIATED WITH PREGNANCY

Pyelitis

Pyelitis means an inflammation of the renal pelvis, but it is hardly possible for the infection to be just limited to the kidney pelvis without involving the surrounding renal substance or the ureters. It is therefore more appropriate to employ the term pyelonephritis with ureteritis.

Incidence. The majority of authors place the frequency of pyelitis during pregnancy and puerperium between 1 to 2 per cent. The incidence during pregnancy and during puerperium is about the same. It is usually bilateral but, when unilateral, it is commonly right sided.

It usually occurs in the later part of pregnancy and frequently the infection recurs in the same individual more than once during the course of pregnancy. Moreover, pyelitis during puerperium is more prone to occur in women who have suffered from pyelitis during their previous pregnancies. A common cause of pyelitis during the puerperium is repeated catheterisation during the first few days after delivery.

Causation. Stasis of urine is the underlying cause. It was formerly believed that the cause of stasis was compression of the ureter by the pregnant uterus at the pelvic brim. The greater frequency of right sided pyelitis was attributed by this theory to the tendency for dextro-rotation of the gravid uterus. Another supporting evidence was that pyelitis usually occurs after the 20th week of pregnancy when the growing uterus is likely to exert pressure on the ureter at the pelvic brim.

The present view is that dilatation of the kidney pelvis and the ureters above the pelvic brim, is a constant physiologic process occurring in over 60 per cent of pregnant women as a result of hormonal changes which cause atonicity and hypomotility.

Though the occurrence of stasis of urine is established, it is not definite as to how the organisms reach the kidney pelvis. Two modes are possible: (1) Symptomless bacteriuria occurs in preg-

nant women. It is possible that sometimes the kidney pelvis is infected by these organisms. (2) The commonest gram negative organism causing pyelitis in over 90 per cent of cases is *Esch. Coli* and it probably reaches the kidney pelvis from the intestinal tract along the periureteric lymphatics. (3) Ascending infection following catheterisation.

Clinical Features. In a case of pure pyelitis there is sudden sharp rise in temperature to 102° - 105° with a 'chilly' feeling. The temperature may fall to normal within a few hours, to rise again the next day in a similar manner. In some cases, there is a double rise in 24 hours. When there is involvement of the kidney parenchyma, the temperature, after a sharp rise, falls to some extent, but does not touch normal. Also, the clinical course of pure pyelitis is short, while that of pyelonephritis is much more prolonged.

With the rise in temperature, there is pain in the lumbar region of the back. The pain frequently radiates to the front, along the course of the ureters to the iliac fossae, indicating an associated ureteritis. When there is unilateral right sided infection, the pain in the right iliac fossa is likely to be diagnosed as acute appendicitis. Frequency of urine is not marked.

On examination, the most important clinical sign is tenderness on pressure in the costovertebral angle. Tenderness along the course of the ureter, and into the iliac fossae, is present in some but not all cases.

In spite of repeated sharp rise of temperature, the patient does not appear to be toxic, but when the course is prolonged due to pyelonephritis, toxic symptoms are likely to occur.

Finding of pus cells in the urine confirms the diagnosis of pyelitis. In women it is useless to examine an ordinarily collected sample of urine, as contamination by vaginal discharge is almost certain to occur. The woman is directed to clean the vulval area thoroughly by cotton soaked in warm water. She is asked to collect midstream sample of urine into a wide mouthed bottle. Urine collected in this way is comparable to a catheter sample. The urine is highly acidic, contains some albumen and pus cells in the centrifuged deposit. Even finding of as few as 6-8 pus cells per low power is diagnostic of pyelitis. The presence of red blood cells and casts indicates pyelonephritis.

Treatment. Sulphonamide therapy is very effective method of treating infections of the urinary tract. Highly soluble preparations should be used to minimise the risk of crystalluria. One

gram, four times a day, controls the infection within a few days in 90 per cent of cases.

The highly acidic urine must be alkalinized and kept alkaline. This is best accomplished by giving 2 gm. of sodium citrate and 2 gm. of sodii bicarb every 4 hours until the urine becomes alkaline; and then the dosage is regulated by testing alkalinity of urine twice a day.

Cases resistant to sulphonamide therapy are treated by giving broad spectrum antibiotics. A sensitivity test on the cultured organisms will determine the appropriate antibiotic. Broad spectrum antibiotics, like chloramphenicol and tetracycline, are more effective on gram negative organisms. These drugs are given as 250 mg. oral capsules four times a day. Organisms sensitive to streptomycin should be treated with $\frac{1}{2}$ gm. streptomycin intramuscularly twice a day.

Nitrofurantoin (Furadantin) is also an effective drug. The average dose is eight, 50 mg. tablets per day, 2 tablets given with each meal, and 2 on retiring at night with milk.

Before the era of sulphonamides and antibiotics, long standing cases of pyelonephritis presented a problem. For proper drainage of the kidney pelvis, ureteric catheterisation was resorted to, a treatment which has completely gone out of practice.

Termination of pregnancy for cases of chronic recurring infection, is practically never undertaken nowadays.

Cystitis

Cystitis seldom occurs during pregnancy, but infection of the urinary bladder following delivery, is a fairly common complication of early puerperium. The predisposing factors during the puerperium are: (1) repeated catheterisation, and (2) oedema and hyperaemia of the base of the bladder during labour. Funnell et al cystoscoped 71 patients immediately after delivery, and concluded that the "insult to the urinary bladder is directly proportionate to the length of labour and the trauma of operative delivery". Blood stained urine, when labour is unduly prolonged, is frequently due to submucous extravasation of blood.

Clinical Features. Intense pain in the hypogastric region occurs with marked day and night urge to pass urine when only a few drops are voided each time. There is rise of temperature which seldom reaches beyond 101°F. The patient being most of

the time on the bed pan suffers from sleeplessness and exhaustion.

Treatment. Ambulation of the patient, even as early as within a few hours of delivery in order that she can pass urine naturally is a useful prophylactic measure to avoid catheterisation. The use of parasympathomimetic drugs is also useful in the treatment of post partum retention of urine.

Even with the best of asepsis and meticulous technique employed for catheterisation, there is a risk of infecting the bladder; hence, should repeated catheterisation become unavoidable, it is better to put an indwelling catheter for a few days. To reduce strangury and pain, instillation of an ounce of 3 per cent silver nitrate solution or an ounce of 1 per cent mercurochrome solution, two or three times a day, is advisable.

Congenital Anomalies of Urinary Tract

Pelvic Ectopic Kidney. Dystocia due to a pelvic ectopic kidney is a rare complication. An excellent review of 112 cases, collected from world literature by Anderson et al in 1948, presents valuable clinical material.

Unilateral ectopic pelvic kidney occurred once in 4,886 pregnant women, while bilateral pelvic kidney occurred once in 34,206 deliveries.

A simple unilateral pelvic ectopic kidney is the commonest, while in a few instances, bilateral pelvic kidney, with or without fusion, was found.

An ectopic pelvic kidney does not cause dystocia in many cases, and Anderson et al found that approximately 30 per cent of the cases were diagnosed years after pregnancy, or were discovered at autopsy. More than 75 per cent of the cases had spontaneous vaginal delivery.

It is difficult to make a diagnosis of pelvic kidney during pregnancy, unless the possibility is kept in mind by the obstetrician. A previous history of difficult labours with urinary tract symptoms, will give a clue to the possibility of an ectopic kidney being the cause of dystocia.

By the judicious selection of cases, a vaginal delivery or delivery by caesarean section can be achieved. Most cases of unilateral ectopic pelvic kidneys will deliver spontaneously, provided there is adequate pelvic capacity. Cases of bilateral pelvic kidney,

or cases in which all of the kidney tissue is in the pelvis, are better delivered by caesarean section.

Polycystic Disease of Kidneys. Very few cases of polycystic disease of the kidneys have been reported. Morris in 1952 and Millar in 1953 have brought forward useful clinical material. The disease is usually bilateral, and there is a strong hereditary tendency, with a record of its occurrence in four successive generations.

Though the condition may remain symptomless during pregnancy, there is a great likelihood of a persistent urinary infection. At present, with a wide range of antibiotics, urinary infection can be effectively controlled, and the question of termination of pregnancy does not arise.

Severe hypertension is a serious complication associated with this condition, and should hypertension develop in the earlier months of pregnancy, the outlook is poor and pregnancy should be terminated. When pre-eclampsia occurs in a case of polycystic kidneys, the prognosis is serious as further renal damage in an already damaged functioning renal tissue must inevitably occur.

The diagnosis can be made by pyelography, if the possibility of this condition is borne in mind, in cases of persistent renal infection, or in cases of hypertension occurring in early pregnancy.

Management. In the absence of abnormal signs or symptoms, polycystic disease of the kidneys is not a contraindication to continuation of pregnancy.

Grossly enlarged kidneys in the foetus may cause dystocia and a number of babies are either stillborn or die early in childhood from anaemia.

The advisability of puerperal sterilization as an eugenic indication, should be considered because polycystic disease is hereditary.

Trauma to Urinary Tract

Trauma to Urinary Bladder. *Obstetric Trauma.* There are two ways by which urinary fistulae occur: (1) due to pressure necrosis and sloughing of the tissues, and (2) as a result of injury during obstetric operations. Pressure necrosis accounts for the majority of fistulae occurring as a sequel to protracted labour. In some of those which occur after an obstetric operation, the instrumental delivery is the precipitating factor because the soft parts devitaliz-

ed as a result of prolonged compression and oedema are readily injured.

Pressure Necrosis. The sequence of events in a difficult labour which lead to prolonged compression of the soft parts with sloughing, are as follows: Generally, it is a case of cephalopelvic disproportion, either due to a generally contracted or a flat pelvis, or sometimes due to an abnormal presentation. There is usually premature rupture of the membranes in such cases, and the uterine contractions then exert direct pressure on the foetus, and the presenting part is forced against the symphysis pubis or is forced into the pelvic cavity, and impacted therein. In the case of a generally contracted pelvis, the further the head is forced into the pelvic cavity, the more firmly it gets impacted, and the soft parts are more tightly compressed against some part of the bony pelvis, usually the back of the symphysis pubis. In the case of a flat pelvis, the projecting sacral promontory prevents the descent of the head, and the strong uterine contractions force it against the symphysis pubis.

Injury during Obstetric Operations. A sharp instrument, such as a perforator or a spicule of cranial bone, may directly injure the bladder, but the majority of cases occur after forceps delivery. Emmet, many years ago, emphasised that fistula is caused more often by delay in applying forceps when the head is impacted, than by the forceps application itself. In such cases, the compressed, oedematous soft parts, are readily lacerated during operation. Injudicious use of the obstetric forceps before the cervix is fully dilated, or when the head is high, is likely to cause extensive tearing of the cervix, and even injury to the ureters. In a difficult forceps or a craniotomy operation, the cervix or the vagina may be nipped between the forceps or between the cranioclast, and the symphysis pubis, so that the bladder is severely traumatised. This is much more likely to occur when the bladder has not been emptied before operation, because a distended bladder is much more liable to injury.

The bladder may be injured during caesarean section in one of the following ways:

(1) When caesarean section is performed after a prolonged labour the bladder is often raised high up into the abdomen and may be incised while opening the peritoneum. It is therefore wise to open the peritoneum at the upper end of the abdominal incision.

(2) In a repeat caesarean section, the bladder may be adhe-

rent to the lower segment, and may be traumatised during the separation of the adhesions.

(3) The folded upper edge of the bladder is, at times, mistaken for reflection of the utero vesical peritoneum, and the bladder has been incised from side to side on more than one occasion at the N.W.M. Hospital, by experienced members of the staff.

(4) When the longitudinal incision in the lower uterine segment inadvertently extends downwards, it may involve the bladder. Extension of the longitudinal incision may also occur during the delivery of the foetus.

(5) Rupture of the stretched lower segment, at times, involves the bladder.

Injury to Ureters. A cervical tear, or a vaginal tear extending into the vaginal vault, may directly injure the ureter. What is more likely is injury to or ligation of the ureter during attempts to control bleeding from such tears.

The lower part of the ureter is likely to be involved during total hysterectomy for rupture of the uterus. In such cases there is usually a broad ligament haematoma and the normal anatomical relationship of the structures is altered.

During a caesarean section the incision in the lower segment may extend laterally and injure the ureters. The ureter may be accidentally ligatured whilst controlling bleeding at the lateral angle of the incision.

Management. Immediately after a difficult vaginal delivery, instrumental or otherwise, the vagina and the cervix should be inspected by a speculum.

If a vesico-vaginal fistula results, an indwelling catheter must be kept for 4 to 6 weeks. Spontaneous healing of the fistula commonly occurs on maintaining asepsis, and keeping the bladder empty.

Repair of a vesico-vaginal fistula should not be undertaken for at least two months after delivery, as during this period, spontaneous healing is likely to occur; besides an early repair fails because of friability of the tissues.

Urinary Calculus Associated with Pregnancy

Calculus may be in the kidney, in the ureter, or in the bladder. Considering the physiological stasis of urine in the pelvis of the kidney in pregnant women, formation of a renal calculus dur-

ing pregnancy is rare. Pregnancy may occur in women who already have a calculus in their kidney and, as a rule, such calculi are asymptomatic during pregnancy. Renal colic is rare due to dilatation and hypomotility of ureteric musculature.

The advisability of the surgical removal of the renal or ureteric calculus during pregnancy depends on the term of pregnancy. During the first half of pregnancy, surgical removal can be undertaken without much risk of interrupting pregnancy, but in the later half of pregnancy it is wiser to postpone surgical procedure, until four to six weeks after delivery.

Access to ureteric calculus after the fifth month is difficult or even impossible.

A bladder stone may rarely cause dystocia during labour. At the N.W.M. Hospital, on one occasion, a bladder stone of the size of a hen's egg advanced below the presenting part during labour. It was removed by vaginal cystotomy during labour. Repair of the vesical and vaginal incisions was done immediately after delivery.

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CHAPTER 7

VENEREAL DISEASES ASSOCIATED WITH PREGNANCY

Syphilis

Syphilis, until recently, was a frequent cause of foetal death, but as a result of routine antenatal serological investigation and the introduction of penicillin in the treatment of syphilis, prognosis of this complication has been considerably improved.

Transmission. Undoubtedly, the large majority of cases contract the infection as a result of sexual intercourse. A smaller number contract the disease extra-genitally, e.g. in kissing when the partner has active lesions in the mouth.

Transmission from an infected mother to the foetus occurs across the placenta, in the latter half of pregnancy. Before the twentieth week of pregnancy the *treponema pallidum* is prevented from entering the foetal circulation by the Langhan's cells lining the chorionic villi. After the twentieth week, the Langhan's cells degenerate and the *Treponema* pass through the syncytial layer into the capillaries of the villi.

Serological Investigations During Pregnancy. *Collection of Blood.* The patient must be in a fasting condition for atleast six hours. Five c.c. of venous blood are collected in a dry syringe and allowed to clot in a sterile tube. The serum should be crystal clear, with no evidence of haemolysis.

Flocculation Tests. Kahn and Meinicke are the commonly used flocculation tests employing a "cardiolipin" antigen. V.D.R.L. test uses V.D.R.L. antigen, and is also a rapid and reliable method.

Interpretation of Results. Syphilis should never be diagnosed on a single positive reaction in the absence of clinical manifestations. Increasing attention has been focussed on 'false positive' reactions and it is, therefore, necessary to carry out a second test, preferably by a different method. It is only when the second test is also positive that a diagnosis of syphilis is made.

Effects of Pregnancy on Syphilis. It is an old clinical observation that, frequently, mothers who gave birth to syphilitic offsprings had themselves no clinical evidence of the disease. When

infection occurs just prior to or after conception, the usual signs and symptoms of syphilis are suppressed, and even when they appear they tend to be less severe than in the non-pregnant state. Routine serological tests in the prenatal clinic appear to be the only method of diagnosing most of the cases.

Effect of Syphilis on Pregnancy. Untreated syphilis is a cause of intrauterine or post natal death of the foetus. It was formerly believed that syphilis was a cause of early abortions but, since *Treponema* are unable to cross the placental barrier during the early months of pregnancy, it is unlikely to lead to abortion. If the mother is infected late in pregnancy, the child may escape transplacental infection but may get infected during its passage along the birth canal.

The obstetric history of an untreated case of syphilis is often suggestive. The woman has one or more macerated premature deliveries than perhaps a full term stillbirth, followed by birth of a syphilitic infant. Birth of repeated macerated babies is strongly suggestive of maternal syphilis as the cause, even when serological tests are negative.

Manifestations of Early Congenital Syphilis. Congenital syphilis differs from acquired syphilis in that in the former there is a complete absence of primary lesions and secondary and tertiary lesions are present at the same time. Primary syphilitic lesions lie in the placenta. At birth, the baby is apparently normal. Signs of syphilis begin to appear by 6-8 weeks.

Hepatosplenomegaly. This is the most frequent finding in early congenital syphilis. Though jaundice is rare, a slight icteric tinge may be seen on the skin of the infant. There may be an associated oedema due to hepatic insufficiency and lowered serum proteins with reversal of the albumin globulin ratio.

Skin Lesions. The lesions are so varied in appearance that one should invariably think of syphilis when confronted with an eruption in which the diagnosis is in doubt. Particularly so, if the rash is in the napkin area. Syphilis very frequently involves the palms and the soles. The skin of these parts show desquamation, and sometimes, a bullous eruption. Condylomata lata appear about the anus and the vulva. On the skin, rashes similar to those in secondary syphilis in the adult, may occur. The hair is frequently thin, the nails dystrophic and claw-like, and paronychia may be present (Plate 98).

Snuffles. This is a frequent finding and may be the first mani-

festation of the disease. Breathing is obstructed by syphilitic rhinitis, and there may be a discharge which is blood tinged, causing interference with breathing and nursing. Any discharge in an infant which does not respond to treatment quickly, should be regarded with suspicion.

Anaemia, generalized oedema, and meningo-vascular lesions, may also occur. Osteochondritis is of frequent occurrence, and can be demonstrated by X-rays. The bone changes are characteristic near the epiphysis where the normal growth of the bone is interfered with. There is increase in density, and irregularity in the zone of provisional calcification. The long bones are particularly affected. Periostitis is usually present. Another bone lesion, dactylitis, affects the phalanges and has to be distinguished from tuberculous dactylitis. This latter condition will show bony destructive changes in the X-ray plate, which may go on to fistula formation.

Stigmata of Early Congenital Syphilis. As a result of rhinitis the growth of the nasal bones may be interfered with, giving rise to "saddle nose" deformity. The permanent teeth are frequently affected long before they have erupted. Later, the central incisors, and sometimes, the lateral incisors, at eruption, show notching from erosion of the enamel, *Hutchenson's Teeth*. The teeth are widely spaced, and show a broad base and narrow taper. The permanent upper molars are "dome shaped", poorly enamelled, and liable to decay. *Rhagades* or radiating scars occur about the mouth and anus as fissures.

Treatment. The treatment of syphilis has been entirely changed within the last few years with the advent of penicillin. It would be a good thing, however, to make a brief statement of conditions that prevailed till recently, if only to show the great advantages that penicillin offers.

It was customary for a case of primary sero-negative syphilis to receive atleast thirty injections each of arsenic and bismuth. If the case was sero-positive an extra ten injections of each drug were administered. Alternating "courses" of arsenic and bismuth, ten injections comprising a course, were administered. This treatment was very effective, and penicillin today does not give better results. However, when one considers the length of time involved in the treatment with the heavy metals and their many toxic effects, penicillin, which is equally effective in a period of a few days and with negligible toxic effects, should definitely be considered the drug of choice.

Particularly is this the case in the treatment of maternal and infant syphilis, as the syphilitic process is halted in the minimum of time. In fact, it has been found that penicillin given to the pregnant mother even in the later stages of pregnancy has proved most effective. Although considered unnecessary by many, we would advise, in the present stage of our experience, a repetition of the penicillin course in each succeeding pregnancy, given between the third and the fifth month. Where ample facilities exist for a regular month to month follow up of the patient, penicillin alone would be the treatment of choice.

Aureomycin, chloromycetin and terramycin have been proved to have spirochaeticidal action, but they have not been fully evaluated.

Penicillin in Adult Syphilis. Penicillin may be given in different ways. If the sodium crystalline salt is used, it is customary to give 60,000 units every three hours, day and night, for a total of ninety injections. This keeps the penicillin in the blood at an adequate level to deal with the infection. More recently, the procaine salt of penicillin was combined with 2 per cent aluminium monostearate, which is a water repellent. 600,000 units injected intramuscularly maintain an adequate serum level for a period of 72 to 96 hours. Penicillin aluminium monostearate, P.A.M., is very widely used. It can be given to ambulatory patients. The total dose is six million units. This can be administered as daily injections of 2 c.c. containing 600,000 units for a period of ten days. Some syphilologists prefer to give the injections at two or three days interval, the total dose remaining the same. These various schedules have been tried out in America and Europe, and have been found to be equally efficacious.

In congenital syphilis, under the age of six months, an adequate schedule of treatment would be the following: Total dose of 200,000 units of penicillin per pound of body weight. This should be divided into 120 equal doses of crystalline penicillin G sodium every three hours, or, if P.A.M. is given, 300,000 units once daily for ten injections. In older children, the dosage is the same as for the adult.

Gonorrhoea

The course of acute gonorrhoea contracted during pregnancy is similar to the disease in the non-pregnant state. The common

sites of infection are the urethra, the Bartholin's glands, and the endocervix. As the upper part of the cervix is sealed by a mucus plug, spread of infection to the Fallopian tubes and the pelvic peritoneum cannot occur.

A woman who has had gonorrhoea prior to conception, and has subacute or chronic gonorrhoea in the lower genital canal, is likely to have a flare up of the dormant infection during labour. Ascending infection of the uterus, the Fallopian tubes, and pelvic peritoneum, is then likely to occur.

The infection of the eyes of the new born during its passage through the genital canal is a serious complication, and unless promptly treated, ulceration of the cornea with resultant opacity, or panophthalmitis may result. Any purulent discharge from the eyes on the second or the third day, should be promptly diagnosed by Gram staining of a smear of pus, and vigorously treated to prevent complications.

Prophylactic use of instillation of 1 per cent silver nitrate solution into the eyes immediately after birth, advocated by Credo, was formerly universally practised, but at the present time it is considered by many as unreliable and irritating. Some people have suggested the prophylactic use of penicillin eye ointment, or penicillin eye drops, to prevent ophthalmia neonatorum, and claimed very good results.

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CHAPTER 8

MENTAL AND NERVOUS DISEASES ASSOCIATED WITH PREGNANCY

Epilepsy

Pregnancy frequently occurs in epileptic women and the character and frequency of fits may remain unaffected. In some cases, the seizures are increased and may induce a status epilepticus.

Difficulty in diagnosis occurs when epilepsy manifests first during pregnancy, as then it needs to be differentiated from eclampsia. The absence of chief signs of toxæmias of pregnancy, namely, oedema, hypertension and albuminuria, helps in reaching a correct diagnosis.

The treatment of epilepsy in the pregnant is the same as in the non-pregnant. The hereditary factor has to be considered, but the risk of epilepsy being transmitted is not more than 1 in 10, and therefore therapeutic abortion is not indicated.

Chorea

It is a rare complication occurring once in several thousand deliveries. Ellis reported 4 cases in 39,000 pregnancies at the Boston Lying-in Hospital. Most of the cases have a history of preceding streptococcic rheumatic infection, and show evidence of endocarditis. Pregnancy is unaffected by chorea as shown by the recent study of Beresford and Graham. In 127 cases collected from various British hospitals between 1938 and 1948, there was only one death as a direct result of chorea. Psychosis is a serious complication of chorea. The treatment of chorea is by hypnotic drugs as in non-pregnant women.

Cerebro-vascular Accidents During Pregnancy

Intracranial haemorrhage is a much more common accident, and a cause of maternal death, than is generally realised. The commonest cerebro-vascular accident is subarachnoid haemorrhage

caused by the rupture of either a congenital aneurysm in the 'circle of Willis' or by an angiomatic malformation. This accident is commonest during the third trimester of pregnancy, which is the peak period of cardiac load. Only 25 per cent of cases occur during labour or immediately after delivery, so that the sudden strain of labour seems to play a comparatively minor part. In 1963, Mukherji reported two cases of intra-cerebral haemorrhage following delivery.

Headache and vomiting are such common symptoms of pregnancy that it is not surprising that the occurrence of cerebro-vascular accident is frequently missed. An unexplained coma, with or without neck rigidity and convulsions, or a persistent headache with or without focal signs, must be investigated.

Lumbar puncture under manometric control must be done. If the cerebro spinal fluid is blood-stained, or the supernatant fluid is xanthochromic, cerebral angiography must be carried out without delay. The cerebro spinal fluid may be blood stained in case of severe toxæmia with hypertension, cerebral oedema, or vasoconstriction as a result of several fits. Normal blood pressure and urine report exclude pregnancy toxæmia.

In older women with arteriosclerosis, the haemorrhage is usually intra-cerebral. The prognosis is poor and surgery has little place. In young women with normal kidneys and cardio-vascular system, surgical evacuation of haematoma is often successful, with none or slight residual debility.

Neuritis

Severe and fatal neuritis is a rare complication of pregnancy, but neuritis of a single nerve is more common. Often, fatal cases of polyneuritis accompany or follow hyperemesis gravidarum. The etiology is not definite, but there is no doubt that it is due to deficient intake of vitamin B complex. It is, therefore, advisable to give vitamin B complex to all pregnant women.

Poliomyelitis

Pregnant women are said to be more susceptible to poliomyelitis than non-pregnant ones. The virus of poliomyelitis rarely crosses the placental barrier, but a few cases of placental transfer have been reported.

Poliomyelitis does not affect uterine motility, and a normal vaginal delivery is usually possible.

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CHAPTER 9

VIRUS AND PROTOZOAL DISEASES ASSOCIATED WITH PREGNANCY

Viral Diseases

Before 1941, virus infections during pregnancy had a limited clinical interest. In that year, Gregg reported from Australia a series of 78 cases of congenital cataract, in 44 of whom a congenital heart lesion was also present. He drew attention to the clinical evidence that in 67 of these cases, the mother had suffered from an attack of rubella during pregnancy. As a result of this, interest was stimulated in the relationship between congenital foetal abnormalities and rubella. Later, surveys were carried out which included maternal infection with other common virus diseases, such as measles, influenza, small pox and chicken pox. The authoritative report of Mansen, Logen and Loy in 1960, published by the British Ministry of Health, reveals interesting data and several of their conclusions have been included below.

Small Pox. Infection during the early weeks is likely to lead to abortion. When small pox occurs later in pregnancy, there is a possibility of the infant being born with fresh pustules or pock marks depending on how near term the mother had small pox. The virus of small pox can cross the placental barrier from early pregnancy. Though the mother may be immune, the virus contracted through exposure to small pox during pregnancy, can reach the foetus, without the mother developing the disease.

During pregnancy, virulent form of haemorrhagic small pox is now and again observed. Sharp rise of temperature and intense backache are the most prominent symptoms, and a diagnosis of small pox is made on the basis of these two symptoms even before the rash develops. The patient becomes severely toxic, and frequently dies in a couple of days after the eruption of the haemorrhagic pustular rash.

Primary or secondary vaccination during pregnancy should be done whenever there is an epidemic of small pox. Though there is a slight potential risk of congenital malformation occurring in the child as a result of vaccination in the first trimester of preg-

nancy, it must be done without hesitation for the safety of the mother.

Varicella (Chicken Pox). The virus of chicken pox crosses the placental barrier, and the infant may be born with the typical rash if the mother gets infected near term. The investigations of Mangesen, Logan and Loy indicate that chicken pox does not cause foetal maldevelopment.

Rubella. The relation between maternal rubella and subsequent congenital foetal abnormalities has been established. The virus circulates in the maternal blood during the incubation period and crosses the placental barrier. In 558 cases collected by Swan, rubella was contracted by the mother in the first four months of pregnancy in 519, i.e. 93 per cent. The time at which the rubella infection occurs is therefore important, and congenital foetal abnormalities are rare following rubella infection occurring after the fourth month.

The commonest abnormalities are: bilateral central cataract, deaf mutism, and cardiac lesions. Other recorded lesions are microcephaly, mental deficiency, buphthalmos, microphthalmos, and various deformities of the skeletal and nervous systems. Once differentiation has taken place in any organ, it is not damaged by the rubella virus.

The nature of abnormality is closely related to the time when the mother contracts rubella. When infection is in the fourth to the sixth week of pregnancy, ocular defects most commonly occur. In the fifth to the ninth week, congenital cardiac lesions most frequently occur, the common cardiac malformations being patent ductus and inter-ventricular septal defect. Deafness occurs when infection is between the eighth and the twelfth week.

The high incidence of foetal defects reported in Australia is fortunately not found in other countries. It probably varies in different epidemics. A certain degree of lifelong acquired immunity exists in persons who have had rubella during childhood, but cases have been reported where the pregnant woman, as a result of having come in contact with a person having rubella, delivered a deformed infant, although she did not herself manifest clinical evidence of rubella.

The question of therapeutic abortion arises when a pregnant woman has developed rubella in the first trimester of pregnancy, and this procedure is justifiable. As the law stands at present, the termination of pregnancy to avoid a deformed child is illegal.

Measles. Maternal measles towards term, frequently results in premature labour. The child in such cases may be born with a rash, or develop measles within two weeks after birth, which proves that the virus of measles crosses the placental barrier. Measles contracted during early weeks of gestation, frequently leads to abortion.

Mason et al, from a study of 103 cases of measles during pregnancy, found foetal abnormalities in 7 per cent, which is considerably higher than the control figure of 2.8 per cent. However, a definite relationship between the development of foetal abnormalities and the term of gestation could not be established, as in rubella.

Influenza. As in other acute infectious diseases, influenza in the early months frequently leads to abortion, and in the later months to premature delivery.

Recently, Coffey and Jessop studied 663 women who developed Asian influenza during the first trimester, and found that the incidence of congenital abnormalities in the infants was 2.4 times higher than in a control series. But, in several other studies, there was no evidence of foetal abnormalities when the mother contracted influenza in the first trimester.

Parasitic (Protozoal) Diseases

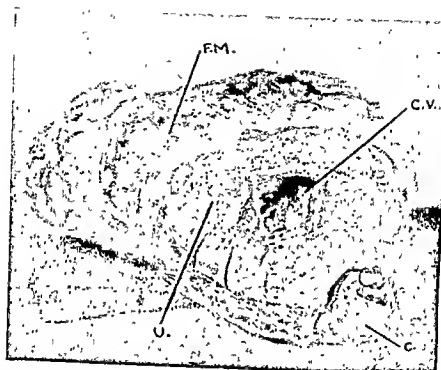
Malaria. Some years ago, malaria was a common affliction, and naturally, pregnant women suffered from it. But, in recent years, the incidence of malaria has been considerably reduced in many parts of India. The infection may be Benign Tertian or Malignant Tertian.

A woman who has latent malaria is likely to have sudden exacerbation. On the other hand, an acute infection may occur during pregnancy. In either case, high temperature with rigors is likely to cause abortion or premature delivery. As a rule, infection with Benign Tertian parasite is unlikely to disturb pregnancy; but with Malignant Tertian infection, premature termination of pregnancy is prone to occur. Cerebral malaria is the most grave form of the disease, and it is then difficult to differentiate the convulsions and coma caused by cerebral malaria from eclampsia. Cerebral malaria is frequently fatal.

Clinical evidence indicates that merozoites do not cross an intact placental barrier, but when there is rupture of the villi, as during labour, the placental defect so caused, allows the merozoites



Pl-98. Congenital syphilitic rash. (Courtesy. N W. M Hospital Museum, Bombay. (p 343)



Pl-99 Pregnancy in a fibromyomatous uterus u, uterus; c, cervix; f.m. fibromyoma; c.v. chorionic villi (Courtesy N W M. Hospital Museum, Bombay) (p. 354)

to enter the foetal circulation.

Management. Before the introduction of various drugs which act on the erythrocytic cycle of the malarial parasite and suppress the disease, quinine was the only available drug. The drug commonly used today are mepacrine, 200 mg. four times a day for the first day, and then 100 mg. three times a day for a week. Chloroquine base is given by mouth, 600 mg. as the first dose, 300 mg. after six hours, and then 300 mg. daily for a further period of two days. For cases of cerebral malaria, 400 mg. of Chlroquine base is given slowly, as an intravenous drip, dissolved in 500 ml. of normal saline.

Toxoplasmosis. In 1937, Wolf and Cowan described toxoplasmosis. The protozoon is commonly found in rodents and birds. Though the pregnant woman may not show any sign of the disease, it is found to be transmissible to the foetus. After reaching the foetus, it may cause foetal death, or premature delivery, or the child may present evidence of the disease at birth, or in the first few days of life. Infection of the foetus occurs only during the active stage of the disease, and there is no danger of infection in a subsequent pregnancy.

The clinical manifestations of the disease are fever, a maculopapular rash, hepatomegaly, lymphadenopathy, jaundice and convulsions. In over 90 per cent of the cases there is choroido-retinitis, and examination of the ocular fundi is useful in diagnosis. In many cases, there is cerebral calcification, and an X-ray of the skull should be taken. The cerebro-spinal fluid is xanthochromic and contains many cells, and the parasites may be present in the centrifugalized deposit.

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CHAPTER 10

TUMOURS COMPLICATING PREGNANCY

Fibromyomata

Fibromyomata play a dual role in obstetrics. Multiple growths or even a small single one can impair fertility, but it is also common to find pregnancy occurring in a fibromyomatous uterus. Due to early marriages in the low income group of patients in India, it is uncommon to meet with cases of fibromyomata during pregnancy in hospitals, but as a result of late marriages in the higher income group such cases are frequently observed in private practice (Plate 99).

In the majority of cases, the course of pregnancy and labour remains unaffected. The complications arising in some of them are best described under: (1) the effect of pregnancy, labour and puerperium upon fibromyomata; (2) the effect of fibromyomata upon pregnancy, labour and puerperium; (3) diagnostic problems; and (4) management.

Effect of Pregnancy, Labour and Puerperium upon Fibromyomata. The usual effect of pregnancy on these tumours is to *increase their size* due to oedema and increased vascularity. The tumours become so soft that a pedunculated myoma is frequently mistaken for an ovarian cyst. Within a few weeks after delivery, they become incredibly small.

Necrobiosis ('Red Degeneration'). Of all the degenerative changes that occur in a fibromyoma, necrobiosis, 'red degeneration', is commonly found during pregnancy. The cut surface is red in colour due to diffusion of blood pigments. It emanates a peculiar fishy odour due to autolysis of muscle, the breaking up of proteins, and the formation of mercaptans.

Histologically, it shows diffusion of blood and blood pigments among degenerated muscle fibres and connective tissue.

The affected growth becomes painful and tender. Rise of temperature and vomiting are frequent symptoms. The symptoms subside within a few days, and myomectomy is rarely necessary. One or more, but not necessarily all, tumours undergo degeneration at the same time.

Torsion of the pedicle of a subserous fibromyoma, during pregnancy, is a rare complication. As the fibromyoma gets softened during pregnancy, it is usually mistaken for a twisted ovarian cyst.

Infection. It is a rare complication and infection of the growth can occur in one of the following ways: (1) A subserous growth which has been devitalised by torsion of its pedicle may get infected from the surrounding adherent coils of the intestine. (2) A small undiagnosed fibromyoma situated in the pelvic cavity, may be traumatised during the passage of the foetus alongside it, and gets infected from the adjacent colon. (3) Necrosis of a submucous growth bruised during childbirth, gives rise to signs and symptoms of puerperal sepsis. During puerperium, secondary post partum haemorrhage sometimes occurs from the necrosis of an infected submucous growth.

Effect of Fibromyoma upon Pregnancy, Labour and Puerperium.
Abortion. Subserous growths do not affect the course of pregnancy; but multiple intramural growths sometimes cause abortion by interfering with the growth of the uterus. When embedding occurs on a submucous fibromyoma, a very early abortion occurs, which is likely to be mistaken for a delayed profuse menstruation.

Pressure Symptoms. When pregnancy occurs with a fibromyoma situated in the pelvic cavity, impaction of the uterus in the early weeks is likely to occur, causing pressure on the urethra and the bladder with retention of urine.

In later months of pregnancy, an excessively enlarged fibromyomatous gravid uterus may give rise to cardiac and respiratory embarrassment from pressure on the diaphragm.

Torsion of Uterus. Sometimes, a pregnant myomatous heavy uterus gets twisted over the softened cervix, and gives rise to a clinical picture very much like concealed accidental haemorrhage.

Malpresentations. A fibromyoma situated in the pelvic cavity is likely to cause oblique or transverse lie from the upward displacement of the foetus. Similarly, lateral displacement of the presenting part occurs when the fibromyoma is situated in the broad ligament.

Uterine Inertia. Multiple intramural fibroids are likely to cause interference with normal uterine action, and lead to prolonged labour. Buckell reports uterine inertia with a prolonged first stage of labour in 9.1 per cent of cases.

Interference with Cervical Dilatation. A cervical fibroid, irrespective of its size, almost always interferes with the dilatation

of the cervix, usually necessitating an abdominal delivery.

Mechanical Obstruction to Labour. Fibroids lying in the region of the isthmus tend to be drawn upwards with the advance of pregnancy. But cervical fibroids fail to be thus drawn out of the pelvis and obstruct labour.

Inversion of Uterus. A large fundal fibroid may lead to inversion of the uterus during the third stage of labour or during the puerperium.

Subinvolution. A uterus studded with fibroids is unlikely to involute normally.

Diagnostic Problems. *Difficulties in Diagnosing Pregnancy.* When conception occurs in a uterus studded with fibromyomata, there is difficulty in diagnosing pregnancy. In the early months, the only way of diagnosis is by a biological test. When pregnancy has advanced to 16-20 weeks, external ballotment may not be possible, and then the presence of internal ballotment is a valuable sign. The presence of "uterine souffle" is misleading, as it is sometimes present in a non-gravid myomatous uterus. After the fifth month, the foetal skeleton can be seen by an antero posterior radiograph of the abdomen.

A uterus which is uniformly enlarged by a single intramural growth is likely to be mistaken for a pregnant uterus. But, when a pregnant uterus is mistaken for a fibromyomatous uterus, the mistake is unfortunate as an unnecessary opening of the abdomen is done. It should therefore be a wise rule to exclude pregnancy before an operation, by a biological test or by radiology.

Pregnancy in One Horn of a Bicornuate Uterus. Either the small, non-gravid half is considered as the uterus, and the other half enlarged by pregnancy is diagnosed as a fibromyoma, or the pregnancy is correctly diagnosed, and the non-gravid half, often displaced in the pelvic cavity, is mistaken for a fibromyoma.

A pedunculated subserous growth softened by pregnancy is often wrongly diagnosed as an ovarian cyst, more so if there is torsion of the pedicle.

Retention of Urine. In the second or the third month of pregnancy, retention of urine by an incarcerated pelvic fibromyoma may be mistaken for a retroverted incarcerated gravid uterus. The direction and position of the cervix aids in differentiating the two conditions. In a retroverted gravid uterus, the cervix points almost vertically forwards; while a pelvic fibromyoma will push the cervix behind the symphysis pubis, and it will be pointing down-

wards or downwards and backwards. If the external os is seen to be crescentic in shape, the diagnosis of a posterior cervical fibromyoma is made.

Differential Diagnosis of 'Red Degeneration' Acute Appendicitis. In the early weeks of pregnancy, red degeneration of a fibromyoma situated on the right side of the uterus, is very likely to be mistaken for acute appendicitis. Pain in the right lower abdomen, tenderness, vomiting and the rise of temperature in cases of red degeneration closely simulate the clinical picture of acute appendicitis. Amenorrhoea should put the clinician on his guard, and a vaginal examination is usually sufficient to avoid the mistake. After the fourth month, when the enlarged uterus can be palpated per abdomen, the localised tenderness on the uterus helps in the diagnosis of 'red degeneration' of a fibromyoma.

Ectopic Pregnancy. 'Red' degeneration of a laterally situated fibromyoma in the early weeks of pregnancy, is likely to be mistaken for an ectopic pregnancy. The points of differentiation are that in ectopic pregnancy all the fornices are extremely tender on vaginal palpation, while only one lateral fornix is tender in a red degenerated fibromyoma. Also, a fibromyoma is a well defined tumour attached to the uterus, while an ectopic mass is ill-defined, and is of varying consistency.

Management During Pregnancy. The majority of cases are symptomless, and are diagnosed during routine prenatal examination. A vaginal examination, to exclude a pelvic growth, must be done.

Retention of urine with the tumour impacted in the pelvic cavity, is treated by rest, enema, and the introduction of a self-retaining catheter. Usually, the pressure is relieved as the uterus becomes an abdominal organ, and surgical intervention is seldom necessary.

Pressure on the diaphragm by large tumours usually occurs in the later part of pregnancy. Rest in Fowler's position, and other general measures should be tried; but, if the discomfort becomes intolerable, pregnancy is terminated by rupturing the membranes, or by caesarean section.

'Red degeneration' during pregnancy is treated by rest, sedatives, analgesics, and other general measures. The acute symptoms subside within a few days, but recur in the same or some other tumour. Myomectomy during pregnancy is serious operation. There is profuse bleeding from the vascular gravid uterus, with

chances of abortion after the operation. It should therefore be undertaken only under exceptional circumstances.

Acute abdominal emergency requiring laparotomy due to torsion of a pedunculated fibromyoma or of a gravid myomatous uterus rarely arises.

Management During Labour. When the fibromyomata are situated in the upper part of the body of the uterus, labour proceeds normally in most cases. There may be incoordinate uterine action with prolonged first and second stages of labour. Theoretically, the incidence of atonic post partum haemorrhage in a fibromyomatous uterus should be high, but, in practice, a fibromyomatous uterus contracts and retracts as well as a normal uterus. Sometimes, when part of the placenta is attached to the submucous fibromyoma, the placenta remains partially adherent, and causes post partum haemorrhage. Immediate manual removal is then necessary.

A large tumour situated in the pelvic cavity, obstructs labour and requires a caesarean section. Apart from enucleation of a myoma which comes in the way of the uterine incision, myomectomy during caesarean section should not be performed. Not only is the operation prolonged, but serious loss of blood from the vascular gravid uterus makes it a dangerous procedure. Besides, there is a great danger of sepsis setting in.

Tumours of Ovary

The association of an ovarian cyst with pregnancy is encountered now and again. The incidence is 1 in 1500 pregnancies. Carcinoma of the ovary and other solid ovarian tumours are rarely encountered, because they comprise not more than 20 per cent of all the ovarian tumours, and most of them occur after the age of forty.

Any variety of ovarian cyst may occur, but the common ones are simple serous, papilliferous or pseudo mucinous cystadenomas, and dermoid cysts. Bilateral theca lutein cysts are observed in some cases of vesicular mole.

Influence of Ovarian Tumours on Pregnancy and Labour.
Pressure Symptoms. An ovarian cyst, situated in the pelvic cavity and about the size of a foetal head, is likely to get incarcerated during the first three months of pregnancy, and by pressure on the urethra and the bladder gives rise to difficulties in micturition

or even retention of urine. Torsion of the ovarian cyst is most common during puerperium, due to the sudden freedom of movement following delivery. The torsion is usually sudden, and gives rise to signs and symptoms of acute abdomen. Sudden severe abdominal pain occurs and, in many, vomiting is a distressing symptom. The abdomen is distended with "guarding" of the abdominal muscles. When the tumour is abdominal, it is found to be tense and tender, with its motility restricted. A small twisted cyst situated in the pelvic cavity is palpated on vaginal examination as a tense, tender, well-defined tumour in one of the fornices. Retention of urine commonly occurs. Sometimes, the torsion is partial and gradual, and a constant, dull abdominal pain is complained of.

Haemorrhage. Bleeding into the cyst wall, or in its cavity, commonly occurs with torsion of the pedicle, but bleeding may occur as a result of injury to it during vaginal delivery. Haemorrhage into a malignant tumour is also a rare possibility.

Obstructed Labour. An undetected ovarian tumour in the pelvic cavity will prevent engagement of the presenting part, and obstruct labour.

Diagnostic Problems. Diagnosis of Pregnancy. In the early weeks of pregnancy, a small ovarian cyst, with enlarged gravid uterus lying side by side, forms an indistinct pelvic mass, and unless the cyst can be pushed up into the abdominal cavity, it is difficult to confirm pregnancy without a biological test.

Retention of Urine. Three, almost clinically similar, conditions give rise to retention of urine: (a) Retroverted, incarcerated, gravid uterus; (b) gravid uterus with an incarcerated ovarian cyst; and (c) a pelvic haematocele. The position of the cervix is helpful in diagnosis. With a retroverted, incarcerated, gravid uterus, the cervix points directly forward and is pushed behind the symphysis pubis. In a pelvic haematocele, it is also pushed forward behind the symphysis, but is pointing directly downwards, or downward and forward. In a gravid uterus with an incarcerated ovarian cyst, the cervix may be pushed behind the symphysis pubis when the cyst is lying in the pouch of Douglas, or to one side when the cyst is situated laterally. On vaginal palpation, a pelvic haematocele and an incarcerated cyst with a gravid uterus are of indefinite outline and of varying consistency; while a retroverted, incarcerated gravid uterus is smooth and is well defined.

Differentiation from Hydramnios. A large ovarian cyst together with a pregnant uterus causes an enormous distension of the

abdomen, giving rise to pressure on the diaphragm. A plain X-ray of the abdomen will show the foetus situated on one side, with a soft tissue shadow of the tumour on the other side. A repeat X-ray in another position will show the altered position of the foetus in hydramnios, but not so in an ovarian cyst.

Pedunculated fibromyoma may become so soft and cystic, that it may be mistaken for an ovarian cyst.

Management. *During Pregnancy.* There is no uniformity of opinion regarding the management of an uncomplicated ovarian cyst accidentally detected during routine pre-natal examination. Some prefer to keep the case under observation during pregnancy, and operate only when it gets incarcerated in the pelvic cavity, or when it gets twisted.

Ovariectomy in the early weeks of pregnancy before the placenta has formed is likely to cause an abortion. When it is diagnosed during the later months of pregnancy, it is not necessary to remove it because torsion after the sixth month rarely occurs. Besides premature labour may follow an ovariectomy. A weak abdominal scar is most likely to be formed when an operation is performed in the later months of pregnancy due to the unavoidable stretching of the abdominal wall by the gravid uterus.

During Labour. Here again, some advocate abdominal delivery and extirpation of the cyst for all cases. For a cyst lying in the pelvic cavity below the presenting part, a caesarean section and the removal of the cyst at the same time is the only treatment. But, when the cyst is in the abdomen above the presenting part, it is not always necessary to deliver by caesarean section. When labour progresses satisfactorily, a vaginal delivery should be allowed, and the cyst removed after delivery. In a multipara who is to be sterilized, perhaps caesarean section is a reasonable line of treatment, but to weaken the uterus by a deliberate caesarean section, is not advisable in other cases. A cyst might get traumatised during vaginal delivery or get twisted during the puerperium, and a close watch should be kept if vaginal delivery is allowed.

When an ovarian cyst has obstructed labour in an outlying area, the best procedure of overcoming the obstruction is by direct incision of the cyst wall through the bulging vaginal vault. A unilocular cyst will immediately collapse, but in order to collapse a loculated cyst, the septa are broken down by the fingers. The cavity is lightly packed with gauze, and the delivery is effected. Ideally, an incised cyst should be immediately extirpated but in

the absence of facilities, the cavity is plugged by roller gauze, and arrangements made for the transfer of the patient to a hospital. Delay in removing the cyst will result in infection from the vagina or the colon. Apart from infection, delay will cause adhesion of the cyst wall to the vaginal vault and other structure in the pelvis. Removal per abdomen becomes difficult, with the added risk of injuring the colon.

During Puerperium. Soon after delivery, preferably in a day or two, the ovarian cyst, which had been deliberately left alone during pregnancy or pushed up during labour, must be removed to eliminate any chance of torsion or infection.

Cancer of Cervix

Since cervical cancer is often seen during the reproductive life, it is sometimes found during pregnancy. The incidence of cervical cancer during pregnancy is said to be 1:3000 confinements. It is possible that the actual incidence is higher because the diagnosis of cervical malignancy is often missed during pregnancy—the vaginal bleeding usually being attributed to abortion or antepartum haemorrhage. Careful speculum examination of the cervix during pregnancy, especially if there is any vaginal bleeding, cannot be too strongly advocated.

Diagnosis. Although examinations of vaginal smears may raise the possibility of cervical cancer, the diagnosis is only to be made on histological studies. Chronic cervicitis often assumes proliferative features simulating malignancy during pregnancy. The epithelial cells of the cervix may be so altered during pregnancy as to mimic carcinoma in situ. The epithelium invariably reverts to normal after delivery. Lastly, decidual reaction of the cervical epithelium should not be mistaken for a carcinoma.

Effect of Pregnancy on Cervical Cancer. Whether pregnancy hastens the spread of cancer is a moot point. On theoretical considerations, it may be assumed that the increased vascularity of pregnancy tends to accelerate the growth and spread of the cervical cancer.

Effect of Cervical Cancer on Pregnancy. The cancer has no effect on the growth of the foetus and the placenta. But haemorrhage and sepsis may punctuate pregnancy, and complicate labour and puerperium.

Treatment. Immediate and adequate treatment of the cancer,

irrespective of the stage of gestation, should be the rule. Any delay in instituting therapy worsens the ultimate maternal prognosis. On the other hand, surgical treatment inevitably means termination of pregnancy, while radiotherapy may result in abortion, premature labour, still birth, or radiation damage to the newborn. However, except under exceptional circumstances maternal interests should never be sacrificed in favour of the foetus.

I. Foetus is non-viable—

(a) First trimester of pregnancy. The pregnancy should be ignored and the cancer treated by either surgery or radiotherapy, depending on the nature of the disease. Radiotherapy usually results in an abortion.

(b) Second trimester of pregnancy.

(1) If the cancer is curable, the obtaining of a live offspring is of vital importance to the parents, and the pregnancy is just short of viability, curative therapy may be withheld to permit the foetus reach viability. In the meantime, the cervix may be treated by surface application of radium to check the growth of the lesion. Radiation of the foetal head can be avoided by external version of the foetus into breech presentation, prior to the use of radium. When the foetus becomes viable, caesarean delivery should be undertaken, followed by adequate therapy of the cancer.

(2) If the cancer is curable and the foetal life not precious, prompt treatment either by radical hysterectomy or radiotherapy should be undertaken.

(3) If the cancer is advanced, palliative radiotherapy should be started.

II. Foetus is viable—

Classical caesarean section should be done at the earliest, and the disease treated according to its stage.

CHAPTER 11

LEUCORRHOEA AND VERICOSE VEINS ASSOCIATED WITH PREGNANCY

Leucorrhoea

A large number of pregnant women complain of vaginal discharge. The discharge in some has been present even before the conception and such a discharge is often aggravated during pregnancy. In many, however, it is first observed during pregnancy. Vaginal discharge during pregnancy, besides causing personal inconvenience to the patient, has a varied clinical significance and therefore prompt investigation of its cause should be made.

During the first trimester, leucorrhoea is present in many women due to the excess of the normal secretion resulting from the congestion and hyperaemia of pregnancy. The discharge is mucoid and non-irritating and does not require any treatment.

The etiology of pathological discharge during pregnancy is not always definite and, in many, no definite cause can be found on investigation. The common pathological causes are: (1) monilial infection from *candida albicans*, (2) *trichomonas vaginalis* infection, and (3) gonorrhoeal infection.

Monilial Vulvo-vaginitis. It is due to the parasite, *candida albicans*. The parasite is more often detected by the culture of the discharge than by ordinary smear examination. Statistical data varies widely but roughly monilial infection occurs in about 20-25 per cent of pregnant women. It may occur at any time during pregnancy but is noticed more frequently in the latter half of pregnancy. The discharge is profuse, curdy and is very irritating giving rise to vulval pruritus and dysuria.

On examination, the vulva is oedematous, sore, red and often plastered with white curdy discharge. Speculum examination is painful and the vagina appears red and sore, and large amount of cheesy material is seen in the fornices.

Monilial infection is particularly likely when a broad spectrum antibiotic has been administered for several days.

Treatment. The most prompt and effective treatment is to insert a vaginal speculum, swab out the irritating curdy material and

paint the vaginal walls by an aqueous solution of 2 per cent gentian violet solution. The vulva should also be painted. Pruritus and dysuria are relieved after one or two applications but to have a lasting effect the treatment should be continued once daily for a week.

Another effective treatment consists in inserting vaginal pessaries containing 100,000 units of the anti-fungal antibiotic, nystatin. For the first few days, two pessaries are inserted high up in the vagina just before retiring at night and the treatment is continued for three to four weeks by the daily insertion of one vaginal pessary.

Trichomonas Vaginalis Vaginitis. Donne in 1837 discovered trichomonas in vaginal secretion. It is a common infection occurring at all ages, and is particularly common during pregnancy.

Etiology. The mode of infection is obscure but certain predisposing factors are present in some of the cases. Since the widespread use of antibiotics, the incidence of trichomonal infection has increased. A common mode of infection of the vagina is by coitus with an infected male. Socio-economic and personal hygiene have also causal relationship.

Morphology. *Trichomonas vaginalis* is about one and a half times the size of a leucocyte, has four flagella, a granular cytoplasm and a single oval nucleus. It has a constant, rapid, whiplike motion. A dead trichomonas cannot be distinguished from a leucocyte. For detecting trichomonas a wet specimen is most suitable. A drop of discharge collected from the posterior fornix is placed on a clean slide. Two drops of normal saline are added and mixed with the vaginal discharge. After placing the cover slip it should be examined immediately to detect mobile organisms. Presence of trichomonas in the vagina is conclusive but a negative test is inconclusive. Sometimes, cases which are negative on microscopic examination of the smear are positive on culture. A suitable culture medium is Feinburg Whittington liquid oxoid medium.

Clinical Features. Profuse, white or greenish yellow, watery discharge is the usual symptom. In some cases, the irritating discharge causes burning micturition and pruritus.

On speculum examination, the vagina is red in the region of the fornices and portio vaginalis of the cervix. In some, this region of the vagina is dotted with tiny, haemorrhagic spots. Frequently, the irritating discharge causes erosion of the cervix.

Treatment. Many different methods of treating this obstinate

condition have been advocated, but none of them can be considered as specific. With any of the methods, discharge and irritation of the vulva improve rapidly and the trichomonas are eliminated from the vaginal canal but, in many instances, recurrence occurs within a short period.

The principles underlying the various forms of local treatment are: to keep the vagina dry, to maintain vaginal acidity at a level of pH 4.5 to 5.0, to apply chemicals which are lethal to the organism, and to look for and correct principal sources of reinfection. The vagina is kept dry by swabbing out the vaginal walls. The high level of acidity is maintained by employing glucose, lactose or pentose which is converted into lactic acid by Doderlein's bacilli. Many chemicals have been found to be germicidal to trichomonas of which pentavalent arsenic acid, silver picrate, argyrol, sulphonamide powders and 1 per cent aqueous solutions of gentian violet or methylene blue are commonly used. The chief sources of reinfection are cervix, Skene's ducts, Bartholin's glands, bladder, urethra and rectum. In some cases the husband is responsible for reinfection. Reich and his associates have found a high incidence of resistance to treatment in cases who previously had subtotal hysterectomy and they attribute it to a resistant trichomonad focus in the cervical stump.

The chief difficulty in instituting a successful cure lies in securing intelligent co-operation of the patient. As a rule, symptoms abate after a week of regular treatment and soon after patients discontinue the treatment. For treatment to be successful, at least eight to twelve weeks of continuous vaginal medication is necessary with frequent microscopic examination for trichomonas.

During pregnancy, insufflation of powder germicidal to trichomonas should never be used. Cases of air embolism, following this form of treatment, have been recorded. Tablets or suppositories are equally efficacious.

Oral Treatment of Trichomonas. During the last four years, many reports on the effects of metronidazole on trichomoniasis have appeared in British and French literatures. It is marketed under the trade name of Flagyl.

Flagyl is given orally in 200 mg. doses, three times a day for 7 days. During treatment, some patients have gastro-intestinal symptoms, or signs of toxic dermatological reactions occur. Symptomatic relief is obtained within 3 days in the majority of cases and, in all, within a week. The smear and culture become nega-

tive within a few days of the commencement of the treatment.

In as many as 33 of the 100 patients treated by Menon, monilia and yeast organisms occurred during the observation period which suggests that perhaps the effect of the drug was to render the vagina more prone to candida infection. In these cases, there was persistent discharge with pruritus.

The failure rate, during a period of three months' observation, varies and is mostly due to reinfection from the seminal fluid of males. Menon reported a high rate of 43.7 per cent and attributes this high figure to reinfection, irregularity in taking the drug, inadequate absorption, or resistant strains.

Gonorrhoeal Infection. It has already been described.

Varicose Veins

Varicose veins tend to be temporary and improve greatly after delivery and they may even disappear completely. During pregnancy, varicose veins become progressively larger and more numerous throughout pregnancy. They, as a rule, reappear earlier in subsequent pregnancies and eventually become permanent varicose veins.

Varicose veins, when they develop during the first pregnancy, appear in the second or the third trimester. Majority of women who had varicose veins in a previous pregnancy developed recurrent veins in the first trimester in a subsequent pregnancy.

Etiology. Random autopsies on non-pregnant women showed absence of valves in the veins of one or both the legs in roughly 40 per cent of the cases.

Increased pressure inside the veins of the lower extremities during pregnancy has been demonstrated by Veal and Hussig and is an important etiological factor.

Symptoms. Fatigue, heaviness and aching of the lower limbs are common features. Cramps in the calf muscles is also a frequent symptom.

Treatment. Elastic bandages or stockings give some relief, but the present trend is the injection of Sclerosing solution into the lumen of the veins. This gives complete relief and prevents the spread of varicose veins and also has a cosmetic advantage.

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SECTION VII

ABNORMAL LABOUR

CHAPTER 1

DIFFICULT LABOUR (DYSTOCIA)

It is not possible to have a comprehensive definition of abnormal labour. Even normal labour is broadly defined as one in which the vertex presents and which results in spontaneous vaginal delivery within 24 hours without gross trauma to the genital canal or to the foetus. The difficulty in defining abnormal labour arises from the fact that many causes, singly or in combination, contribute towards it. Prolongation of labour for more than 24 hours is not always an abnormal one as frequently after irregular uterine action lasting for more than 24 hours labour progresses quickly and spontaneous vaginal delivery occurs. On the other hand, labours which have lasted less than 24 hours are sometimes so abnormal as to demand aided delivery. Besides these, other factors which affect the course of labour have to be taken into consideration. They are age, parity, the physique and the emotional build up.

The three main factors which determine the course of labour are: (1) efficiency of uterine action, (2) the shape and the size of pelvis, and (3) the size and the position of the foetus. These three factors were described in the past as faults in the (1) passage, (2) passenger, and (3) power.

General Factors Influencing Course of Labour

Influence of Age. There is conclusive clinical evidence that primigravidae below the age of 20 have a much quicker and easier spontaneous delivery than at any other stage. Shiralli and Bhatt analysed the type of labour in 2,000 primigravidae delivered at the N.W.M. Hospital, Bombay, and found the incidence of spontaneous delivery at different ages as follows:

Duration of labour									
Age in years	Less than 12 hours		hours 12-30		hours 31-43		43 hours and above		Total
	No.	%	No.	%	No.	%	No.	%	
Less than 15 years	5		—				—		5
16-20	870	69.0	366	29.0	20	1.9	4	0.3	1260
21-25	313	63.0	262	44.0	12	2.0	3	0.5	590
26-30	66	63.0	31	29.0	7	6.3	1	0.9	105
31 & above	16	40.0	21	51.0	3	8.0	—	—	40
	1270		680		42		8		2000

The incidence of spontaneous delivery in primigravidae, reported by Baird, Duncan and Thompson in 1952 in the Aberdeen Maternity Hospital, was 80.3 per cent in the age group 15 to 19 years, which gradually fell to 26.1 per cent in the age group 35 years and over.

The incidence of forceps delivery increases with advancing age and the largest contributory factors towards this increase are either faulty uterine action or poor expulsive efforts and rigidity of the perineum. The incidence of forceps delivery in Baird's series was less than 3 per cent in the age group 15 to 19 years which gradually increased and was nearly 18 per cent in the age group 35 years and over.

The incidence of perineal tear and episiotomy is also low in the age group 15 to 19 years. It gradually increases with age and after the age of 25 years very few primigravidae can be delivered without an episiotomy.

The caesarean section rate is very low in the age group 15 to 19 years. It steadily rises with age and, above the age of 30 years, it may be as high as 20-25 per cent. Caesarean section is often performed in the elderly primigravidae, either as an elective procedure or early in labour before a full trial has been given, more for securing a live child than for a difficult labour.

Influence of Parity. It is a common clinical experience that the second labour is, as a rule, easy and spontaneous irrespective of whether the first has been spontaneous or forceps delivery. Even when a caesarean section has been necessary for the first, the second is easy and spontaneous except in those having marked disproportion.

From parity 2 to parity 5, there is not much difference in the rate of spontaneous or aided delivery but after parity 5, the problems of grande multiparae arise and the incidence of difficult or complicated deliveries rises.

Physique. In India, the nutritional standards of the majority of women of the lower income group are poor and their physical development correspondingly low. The pelvic measurements are smaller than in the Western countries, but the low birth weight of the infants, 5 pounds to 5.5 pounds, together with early marriages does not materially increase the incidence of difficult labour. In certain parts of the country, due to nutritional and environmental factors, there is still high incidence of rickety flat and triradiate osteomalacic pelvis. Bernard, from the study of the relationship of height, size and shape of the pelvis, found that tall women had pelvises which were mostly gynaecoid or anthropoid, and very few platypelloid, while short women had a large proportion of platypelloid pelvises.

Psychosomatic Factors. The environment in which a woman is brought up has an important bearing in her attitude towards childbirth. Women of the low income group who seek hospital treatment behave quite differently from women of good social circumstances who seek individual attention as paying patients.

In India, owing to early marriages in the hospital class of patients, it is quite common to meet with primigravidae below the age of 20 years, while women of good social circumstances marry late and primigravidae in this class are usually between 25 and 30 years, and quite a number of them are over 30 years. The incidence of spontaneous delivery, caesarean section and forceps rates in the different age groups has already been discussed.

Women of the lower income group have a hard life and their threshold for bearing pain is considerably higher than that of women of good social circumstances. As a result, the demand for relief of pain during childbirth in the free hospital class of patients is negligible in spontaneous vaginal deliveries. On the other hand, women of good social circumstances are not prepared to accept childbirth pain as inevitable and show their anxiety during pregnancy and question the attending obstetrician as to how he proposes to give relief from pain. During the last 30 years an unhealthy trend developed in some countries of resorting to painless childbirth by various forms of anaesthesia which has tended towards greater nervous tension. The recent trend towards what

is called "childbirth without fear" is an example of the swing in the opposite direction. A married woman who is fertile and particularly when a male child is born to her has an acceptable place in her home and is therefore happy to conceive and goes through her pregnancy and childbirth cheerfully for the happy event. This attitude is particularly noticeable in the young primigravidae of the lower income group. In women of good social circumstances, who have married late, the patient as well as the obstetrician are particularly concerned about the child and much depends on the mature judgment of the obstetrician and the reassurance he can give to her. In his anxiety for his reputation, an obstetrician is apt to impart his own subconscious apprehension to his patient.

How far and in what manner emotional factors influence childbirth is not clearly understood. It is a common experience that women who are nervous often have an easy delivery while those who appear to be placid have a difficult labour. It is argued that women who express their 'fear of the unknown' openly are much more stable emotionally than those who have a subconscious emotional tension.

It is probable that functional rigidity of the cervix and inco-ordinate uterine action are due to an overactive sympathetic nervous system. It is likely that adrenaline secreted by the suprarenal glands in anxiety state has some influence on the uterine action.

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CHAPTER 2

PREMATURE RUPTURE OF MEMBRANES

The membranes normally rupture towards the end of the first stage of labour or early in the second stage. The rupture is said to be premature when the liquor amnii escapes during the last few weeks of pregnancy or soon after the onset of labour. It should be stressed that a slight leakage from the hind waters towards term should not be considered as rupture of the membranes because in these cases only a small amount of liquor escapes and the leak seals off allowing the pregnancy to continue. When there is rupture of the membranes proper a large quantity of liquor drains away with the inevitable onset of labour within a short time.

Rupture of Membranes a Few Weeks Before Term. Obstetric complications during pregnancy which predispose to premature rupture of membranes fall into two distinct categories. In the first category are the cases where there is an overdistension of the uterus due to hydramnios or multiple pregnancy. In the second, abnormal lie of the foetus is the causative factor.

Overdistension of Uterus. Hydramnios and multiple pregnancy are the two predisposing causes. Here the progressive rise of intra-amniotic pressure results in premature rupture of the membranes. In cases of hydramnios complicated by gross foetal malformation, premature rupture is a desirable accident. In cases of multiple pregnancy or hydramnios with a normally developed foetus, prematurity of the new born raises its own problems. Hydramnios as a complication in a pregnant diabetic is common and premature labour is desirable because intrauterine death towards term is a recognised complication in these cases and also because the comparatively small size of the foetus allows an uncomplicated vaginal delivery.

Abnormal Lie of Foetus. The two common ones are the oblique or transverse lie and compound presentation. In both, the brunt of intra amniotic pressure falls on the unsupported lowermost part of the membranes. As term approaches, the increasing intensity and frequency of uterine contractions by raising the intra amniotic tension predispose to rupture. Prolapse of the arm and cord are frequent complicating factors and unless prompt measures

are taken, foetal death is inevitable. Even when prompt obstetric aid is available, the newborn may succumb to prematurity.

Premature Rupture at Term or soon after Onset of Labour. The explanation of premature rupture of the membranes in these cases probably lies in the physiological increase in the intra-amniotic pressure due to much frequent contractions of increased intensity. When the presenting part is fitting well, the 'fore' and the 'hind' waters are well separated and only a small amount from the 'fore' waters escapes. Labour in these cases is usually uneventful.

When, however, the presenting part is floating as in cephalopelvic disproportion or other abnormal presentations, most of the liquor rapidly drains out from the communicating 'fore' and 'hind' waters. Obstetric complications in these cases, except for the frequent prolapse of the cord, pertain to the type of abnormal presentation. If labour progresses rapidly its course is uneventful but, when labour is delayed or is prolonged, the foetus, as a result of inhalation of the infected liquor amnii, is likely to develop pneumonia and succumb from it within a day or two after birth.

CHAPTER 3

MULTIPLE PREGNANCY

Multiple pregnancy is grouped in this section because abnormal presentation is very common with multiple pregnancy. Besides, the normal course of labour is sometimes disturbed and even obstructed labour may rarely occur as a result of locking of the twins or due to the presence of a double monster.

Incidence. Kedarnath Das, in 1934, reviewed 186,842,231 births from nine countries and concluded that twin pregnancy occurred once in 90 births. Hellin, in 1895, stated that twins occurred once in 89 births, triplets once in 89², quadruplets once in 89³ and quintuplets once in 89⁴ (Hellin's Law). About 30 cases of quintuplets and only 3 cases of sextuplets are reported.

Multiple pregnancy is more frequent among primitive people. Also, greater the fertility the greater is the incidence of multiple births.

Etiology. There is no doubt that tendency to multiple pregnancy is related to heredity.—Hereditary trait may be on the maternal or paternal side. The incidence is greater when there is a family history of multiple pregnancy on both sides. The incidence of twinning is increased 4-7 times in twin producing families.

There are two kinds of twins. Those formed from two separate ova discharged from the same ovary, or one from each ovary and fertilized by two spermatozoa are known as binovular twins. Fertilization of an ovum by a single sperm and subsequently, during the very early stages of embryonal development, the division of the zygote into two separate parts, each capable of a separate development into a fully mature foetus, results in uniovular twins. Statistics show that binovular twins are 3-6 times more common than uniovular twins.

Binovular Twins. As two separate foetuses are formed independently, they are in fact two conceptions developing in the uterus at the same time. Therefore, there cannot be any genetic similarity between the two foetuses. They may be of different sex or may be of the same sex. If the fertilized ova get attached near each other, the two separate placentae lie so close to each other in the uterus that their margins coalesce giving an appearance of a

single placenta. That this fusion is apparent is proved by the fact that the circulation in the two is quite separate. When the embedding of the two ova is at some distance from each other, two separate placentae are formed.

A ready way of diagnosing binovular twins is by examination of the placenta and membranes. Since each is a separate conception, each will have a separate amnion and a separate chorion. Thus, on examination of the fused septum between the two amniotic cavities, four layers of membranes will be identified (Fig. 57, Plate 100).

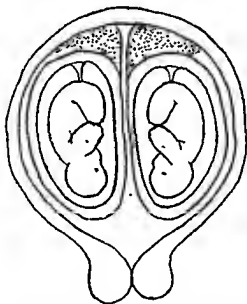


Fig. 57. Placenta and membranes in bin-ovular twins.

Foetus Papyraceus. In binovular twin pregnancy, one foetus may die at an early stage of embryonic development, while the other continues to grow normally. When the dead foetus is retained until the end of pregnancy, it becomes flattened from compression between the uterine wall and the membranes. This flattened, mummified foetus is known as foetus papyraceus (Plates 101, 102).

Uniovular Twins. In the early embryo, there is fission and, if the fission is complete, each is capable of independent development, but, since genetically the two embryos are identical, the sex and the other genetic characters will necessarily be similar in the

two foetuses. The sex will be the same and so also the physical appearances. From medico-legal point of view it should be noted that finger prints are not identical. Blood group may or may not be the same.

The placenta is single; there are usually two separate cords or there may arise from the placenta only one cord which bifurcates to get attached to each foetus (Plate 103).

There is anastomosis of the two blood systems, artery to artery and vein to vein. There is also arterio-venous anastomosis in the villi.

Examination of the placenta does not reveal any evidence of a septum. Since there is one placenta, there is one common chorion for the two foetuses. There are usually two separate amniotic cavities. The septum between the two cavities will therefore consist of two membranes, the adjacent amnions. Sometimes, the two foetuses develop in one amniotic cavity. A rare accident in such a case is twisting of the umbilical cords with arrest of circulation and death of one or both of the foetuses (Figs. 58, 59. Plate 104).

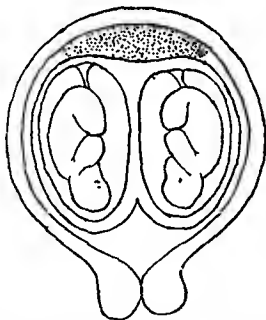


Fig. 58. Placenta and membranes in uni-ovular twins. One common chorion and two separate amniotic cavities.

Acardius Amorphous. Occasionally, as a result of anastomosis of blood vessels, there is an unequal distribution of blood to the two foetuses. If this occurs at an early stage of development, the

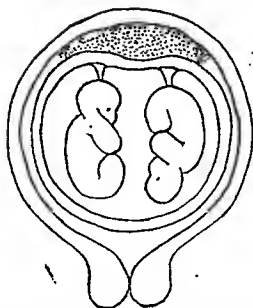


Fig. 59. Placenta and membranes in uni-ovular twins. One common chorion and one common amniotic cavity.

heart of one embryo gets considerably stronger than that of the other and, as a rule, most of the blood from the placenta is received by it. The heart of the other receives less and less blood and eventually it atrophies. Thus, one foetus monopolises the circulation and continues to grow while the other is either represented by a shapeless mass of tissue, *acardius amorphous*, or its circulation may be just enough to develop the lower extremities (Plate 105).

Occasionally, monovular twins have separate placentas. According to Curtius, this occurs in 3.5 per cent of cases. The presence of double or single placentas in monovular twins depends on the time when twinning has taken place. The earlier this occurs the greater is the possibility of separate placentas.

In triplet pregnancies, three possible placental arrangements are: (1) one large placenta with a single chorion and three separate amnions; (2) a double placenta with one chorion and two amnions, and a complete separate placenta with its chorion and amnion; or (3) three entirely separate placentas, each having its amniotic and chorionic membrane.

Superfecundation. This means fertilization of two ova within a short time of each other by spermatozoa from separate coitus.

Superfoetation. This term is used to indicate fertilization of



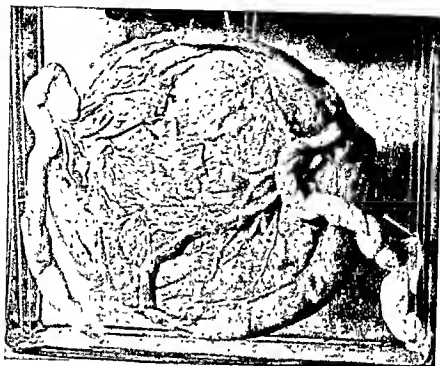
Pl-100. Placenta of binovular twins. (Courtesy N W. M. Hospital Museum, Bombay). (p. 374).



Pl-101 Foetus papyraceous (N W. M Hospital Museum, Bombay). (p. 374)



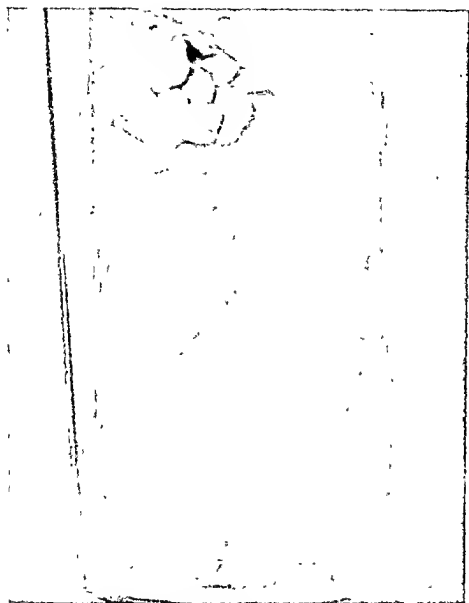
Pl-102. Foetus papyraceous seen at the bottom with its attenuated placenta and umbilical cord. Sac of normally developed foetus seen above. (Courtesy: N. W. M. Hospital Museum, Bombay). (p 374).



Pl-103. Placenta of uni-ovular twins (Courtesy. N. W. M Hospital Museum, Bombay). (p. 375).



Pl-104. Twisting of umbilical cords of a twin pregnancy developed in one amniotic sac (Courtesy. Dr. Y. N. Ajinkya, Bombay). (p. 375).



PI-105. Acardiac amorphous. (Courtesy N W M. Hospital Museum, Bombay)
(p. 376).



Pl-106. X-ray showing both foetuses presenting by the head, (p. 383)





Pl-103 X-ray showing both fetuses presenting by breech. (p. 280).

two ova from different ovulation periods. This does not occur in the humans.

Presentations. In more than 90 per cent of cases of twin pregnancy, both the foetuses lie in the long axis of the uterus, while in the remaining few, one or both the foetuses lie in the transverse axis. In about 50 per cent of cases, both the foetuses are in cephalic presentation (Fig. 60). The next common presentation is one head and one breech (Fig. 61). In a few, both are breech presentation; (Fig. 62).

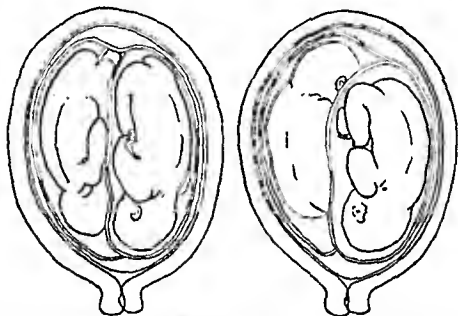


Fig. 60. Both as cephalic presentation. Fig. 61. One as cephalic and the other as breech presentation.

The unusual combinations are, one presenting by the head or breech and the other as a transverse presentation. The rarest combination is both transverse presentations, one foetal sac lying above the other (Figs. 63, 64).

Associated Complications of Twin Pregnancy. In the early months, there is a tendency for excessive vomiting. During later weeks, toxæmia occurs more frequently than in a single pregnancy.

Hydramnios. Excessive liquor amnii in one of the sacs is frequently observed. Hydramnios of one of the sacs is more frequent in uniovular twins than in binovular twins. Hydramnios, supervening on the already overdistended uterus due to twin pregnancy, often gives rise to pressure symptoms like dyspnoea and oedema.

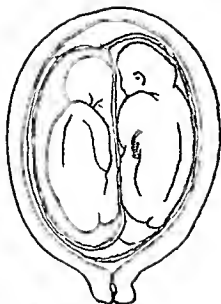


Fig. 62. Both as breech presentation. Fig. 63. One transverse and the other as breech presentation.

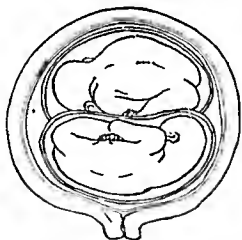


Fig. 64. Both as transverse presentation.

of the lower extremities. The overdistension also masks the clinical diagnosis, and an X-ray film is necessary to establish the diagnosis of twin pregnancy.

Premature labour occurs in many cases.

Diagnosis. Twins cannot be clinically diagnosed before the 24th week. Uterine enlargement out of proportion to the period

of gestation arouses suspicion of multiple pregnancy but the size of the two foetuses being too small they cannot be separately palpated. A diagnosis of twin pregnancy at this early stage can only be established by taking an X-ray film. In multiparae, the lax abdominal wall makes the uterus unduly prominent and this fallacy should be borne in mind.

From 28 weeks onward, diagnosis can usually be made by abdominal palpation. When one foetus is presenting by the head and the other by the breech, diagnosis is simplified by palpating one head at the pelvic brim and the other at the fundus. As a rule, when both are cephalic presentations, one head is at a higher level than the other and the two can be ballotted individually, but it should be remembered that one head might be deeply engaged and may escape palpation. *It should therefore be advisable to always do a vaginal examination in such suspected cases of twin pregnancy.* When both are presenting by breech, diagnosis is made by palpating the two heads at the fundus. It is difficult to palpate two breeches and diagnosis of twin pregnancy is seldom made in this way. When both heads are lying side by side at the same level, the globular outline and ballotment of each, individually, is difficult.

The other signs, such as palpation of an undue number of limbs in the centre as well as on the sides and the palpation of the two backs, are usually made out after one has palpated two separate heads. In other words, these signs are corroborative and sought for after the diagnosis of twin pregnancy is evident from palpation of two heads.

Auscultation. When twin pregnancy has been diagnosed by abdominal palpation, confirmation is sought for by auscultation of two separate heart beats. There is a difference in the two foetal heart rates and it is, therefore, necessary that the rates of two heart beats should be auscultated by two persons at the same time. Auscultation of two heart beats, 4-6 inches apart with a difference of 10 beats between the two, is strongly diagnostic of the presence of twin pregnancy.

Radiological Examination. Antero-posterior plate usually reveals the presence of twins but, when the foetal shadows and the maternal spine overlap, an additional lateral plate is required. In this way, superimposed foetuses can be detected. The exposures should include the whole abdomen as otherwise there is a chance of missing one of the two foetuses. Besides visualising the presen-

tations of the two foetuses, gross foetal abnormality and double monsters can be detected. More than two foetuses are seldom diagnosed by abdominal palpation, and radiography is the only means of diagnosis (Plates 106, 107, 108).

Management. In many cases, labour starts much earlier than the expected date. It is usually stated that overdistension causes a prolonged labour but clinical experience is otherwise. In many cases, the duration of labour is short because, the foetuses being small, dilatation of the cervix and expulsion is easy. When hydramnios complicates twin pregnancy, labour pains are inclined to be weak and labour is prolonged.

Though normal labour is the rule in twin pregnancy, in rare cases locking of the twins or the presence of double monsters causes obstructed labour. It is therefore advisable to ascertain the position of the two foetuses and to exclude double monsters by taking a radiograph towards term. A vaginal examination during the first stage should be done to ascertain that only the head or breech of the first foetus has descended into the pelvic cavity. If, by chance, the presenting part of the second foetus is also trying to engage at the same time, it can easily be pushed up above the pelvic brim. If this preliminary vaginal examination is not done, diagnosis would be made after the progress of labour has been arrested, and then the management would be difficult and, very likely, one of the foetuses would have to be sacrificed.

Unless the lie of the first foetus is transverse, its delivery is usually uncomplicated and should be left to nature. If the first of the twins delivers as breech, suprapubic pressure cannot be effectively made to aid the birth of the after-coming head.

The umbilical cord of the first foetus is divided between two clamps. If this precaution is not taken, the second foetus might lose its blood from the cut maternal end of the first cord, should the twins be monozygotic. The maternal side of the first cord is ligated as then blood loss from accidental 'jumping' of the clamp is prevented. Also, the clamp comes in the way during the birth of the second foetus.

Immediately after the birth of the first foetus. The lie of the second foetus is made out by abdominal palpation because the previous longitudinal lie of the second foetus may suddenly become transverse after the birth of the first. In case of doubt, a vaginal examination should be made. If the lie has become transverse, it should be corrected by external version; but if external

version fails to correct the transverse lie, anaesthesia is given and, after rupturing the membranes, an internal cephalic or podalic version is performed as conditions permit.

The uterus starts contracting within 10-30 minutes after the birth of the first foetus. The membranes rupture and the foetus progresses rapidly through the already dilated passages. The present trend in most clinics is to rupture the membranes of the second foetus immediately after ascertaining the lie of the second foetus.

As a rule, the placenta does not begin to separate until the second foetus is born, but it may start separating after the birth of the first foetus giving rise to bleeding. To reduce the maternal blood loss and to save the foetus, delivery is then hastened by rupturing the membranes at once. Rarely, in binovular twins, the placenta of the first foetus is expelled before the birth of the second foetus.

The third stage may last longer than usual because a larger area of placenta has to separate, but the incidence of post-partum haemorrhage is not particularly high, provided the third stage is properly managed. An intra-muscular injection of some ergot preparation should be given immediately after the birth of the second foetus.

Locked Twins. It is an extremely rare complication, the incidence being 1 in 1,000 twin labours. Lawrence, in 1949, while reporting 3 cases, collected other 28 cases from literature. In this series of 31 cases of locked twins, 25 were primiparae and this high incidence in primiparae is in agreement with other reported series of locked twins. It is suggested that this high incidence in primiparae is due to greater uterine tone in the first than in the subsequent labours. An additional factor, noted in majority of cases, was strong uterine contractions during labour. The combined effect of high uterine tone and strong uterine contractions caused impaction and locking.

In 31 cases, the presentations associated with locking were breech and vertex 16, vertex and vertex 10, vertex and transverse 4, breech and breech 1.

Breech and Vertex. By the time locking is discovered, the first foetus is dead. Under general anaesthesia, an attempt is made to disimpact and deliver the first by breech extraction. The second is then delivered by forceps.

Vertex and Vertex. Under anaesthesia, the second head is pushed up and the first foetus is delivered by forceps. If diseng-

agement fails and the foetuses are alive, a caesarean section should be performed. When both are dead, the first head is perforated, followed by extraction of the first foetus. The second can then be delivered by forceps (Fig. 65).

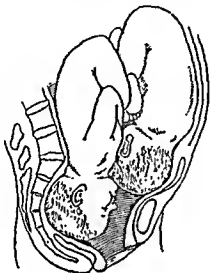


Fig. 65. Locked twins.

Vertex and Transverse. Under anaesthesia, the second transverse is disengaged and pushed up and the first is delivered by forceps. The second is delivered by internal podalic version and breech extraction. If both foetuses are alive, a caesarean section should be considered.

Breech and Breech. Under anaesthesia, the second breech is disengaged and the first is delivered by breech extraction. The second is also delivered by breech extraction.

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CHAPTER 4

FACE PRESENTATION

Whether face presentation should be regarded as an abnormal presentation needs clarification. In 240 consecutive cases of face presentations at the N.W.M. Hospital, Bombay, 92 per cent delivered spontaneously. Except one, all cases of mento-anterior delivered spontaneously. Of the mento-posterior or mento-transverse, more than 50 per cent delivered spontaneously. It is because of the few remaining cases which cause obstructed labour that face presentation is described as an abnormal presentation.

Incidence. At the N.W.M. Hospital, there were 240 cases of face presentation among 43,842 viable confinements, an incidence of 1:183. Parikh reviewing the literature on face presentation found the incidence varying from 1:800 to 1:200.

Etiology. For many years, contracted pelvis, multiparity, placenta praevia, pelvic tumours, multiple pregnancy, hydramnios and foetal malformations were presumed to be important factors causing face presentation. Reviews of large series of face presentations by different writers in recent years have completely altered our concept. Except for a few cases of mild degree of pelvic contraction and the occasional presence of anencephaly, meningocele or dolicocephaly, all other factors to which face presentation was attributed, have been found to bear no causal relationship. It is now believed that most of the cases are primary face presentations due to increased extensor muscular tone in the foetus.

Mechanism of Labour. In every manner, the description of the mechanism of face presentation is directly the opposite of vertex presentation. In vertex presentation, the head is fully flexed and the engaging diameter is suboccipito-bregmatic, 9.5 cm., while in a face presentation the head is fully extended and the engaging diameter is submento-bregmatic, also 9.5 cm. Since the four positions of face presentation are derived from the corresponding vertex presentations, the first vertex (L.O.A.) becomes, by complete extension of the head, right mento-posterior (R.M.P.). The four positions of the face corresponding to the four vertex positions are:—

1st. vertex (L.O.A.) by complete extension of head gives rise to 1st face (R.M.P.), (Fig. 66).

2nd vertex (R.O.A.) by complete extension of head gives rise to 2nd face (L.M.P.), (Fig. 67).



Fig. 67. Right mento posterior (First position).



Fig. 68. Left mento posterior (Second position)

3rd vertex (R.O.P.) by complete extension of head gives rise to 3rd face (L.M.A.), (Fig. 68).

4th vertex (L.O.P.) by complete extension of head gives rise to 4th face (R.M.A.), (Fig. 69).



Fig. 68. Left mento anterior (Third position).



Fig. 69. Right mento anterior (Fourth position).

It will be noticed that while the first and the second face are unfavourable positions because the chin is directed posteriorly,

the third and the fourth face are favourable, the chin being directed anteriorly.

Mechanism. At the commencement of labour, with the chin directed anteriorly, e.g. in the 3rd position L.M.A., the head engages with the submento-bregmatic diameter, 9.5 cm. in the right oblique diameter of the pelvis. Towards the end of the first stage or during the early second stage, there is further descent, whereafter the face rotates through one-eighth of a circle so that the chin comes under the symphysis. The submental region is now fixed under the pubic arch and face, vertex and occiput are successively born by a movement of flexion of the head (in vertex presentation there is extension instead of flexion). (Fig. 70). Resti-



Fig. 70. Mechanism of birth of head in mento anterior position. A. Chin under symphysis pubis. B. Head is born by movement of flexion.

tution promptly occurs. This is followed by external rotation of the head signifying internal rotation of the shoulders, which are born in a manner similar to that in vertex presentation.

In the first position of the face, that is the chin lying posteriorly, long internal rotation through three-eighths of a circle occurs. Further mechanism is as in the mento-anterior position. Should rotation of chin fail to occur, progress of labour is arrested until the chin is manually rotated. In contrast to persistent occipito-posterior position, a persistent mento-posterior can never deliver spontaneously.

Diagnosis. Face presentation can rarely be diagnosed by abdominal palpation during pregnancy. On abdominal palpation when the head is floating, the cephalic prominence is on the same side as the back and the back cannot be distinctly palpated in its entire length. It is diagnosed accidentally by radiography undertaken during the latter part of pregnancy, either for cephalopelvic disproportion or for diagnosing placenta praevia. Face presentation eludes diagnosis to such an extent that, in 60 per cent of the

cases of N.W.M. Hospital series, the diagnosis was made only when the face was seen at the vulva.

A vaginal examination early in labour, with the cervix slightly dilated and the presenting part high, is usually inconclusive. When the cervix is more than half dilated, a face is diagnosed by palpation of the supra-orbital ridges, the nose and the alveolar processes in the mouth.

An inexperienced examiner frequently mistakes a face presentation for a breech. This mistake is much more likely in a case which has been in prolonged labour. In such a case, the markedly oedematous face, obscuring the bony prominences, feels like a soft breech. The alveolar processes in the mouth form a reliable guide even in the presence of oedema.

Management. Clinical experience supported by statistical data shows that, irrespective of mento-anterior or mento-posterior positions, spontaneous delivery occurs in over 90 per cent of cases. In the N.W.M. Hospital, 221 out of a total of 240 cases, 92%, delivered spontaneously.

Mento-anterior Positions. In 204 cases of mento-anterior positions, progress in labour was so satisfactory that it did not become necessary to do a vaginal examination in as many as 145 cases and these were diagnosed only when the face was seen at the vulva. Even when mento-anterior position of the face is diagnosed by a vaginal examination, labour should be allowed to progress naturally. Except for one case, which required a low forceps, the remaining 203 cases delivered spontaneously.

Mento-posterior Positions. More than 50 per cent of mento-posterior or mento-transverse positions deliver spontaneously.

Mento-posterior or mento-transverse positions, diagnosed during the later part of the first stage or early in the second stage, should be carefully observed. In presence of good uterine contractions, long rotation of chin usually occurs with spontaneous delivery. The second stage, however, should not be extended very long because if the uterine contractions are strong and yet descent with forward rotation of the chin does not soon occur, the probable cause is unsuspected pelvic contraction. The face is likely to be jammed into the narrower part of the pelvis making manual rotation of the chin difficult. In the presence of weak pains, it is futile to wait long as descent with forward rotation of the chin is unlikely to occur.

Whenever intervention is decided upon, the choice lies between

manual rotation with forceps delivery and caesarean section. Even when manual rotation and forceps delivery are decided upon, all the preparations for caesarean section should be made so that, should manual rotation fail, a caesarean section can be readily performed. Also, when the second stage is extended in the hope of forward rotation of the chin, the face may be jammed in the narrow part of the pelvis and rotation may not be possible. In any case, if attempts at rotation fail, a caesarean section should be promptly undertaken.

Caesarean Section. A caesarean section would be the choice in a case of mento-posterior in an elderly primipara, previous bad obstetric history and cephalopelvic disproportion with the face remaining at the brim. Besides these, whenever by manual rotation the chin fails to come forward and the foetus is in a good condition, caesarean section should be resorted to.

Manual Rotation of Chin. It is performed under deep ether anaesthesia. A proper examination is made to find out how low the head has come, because even when the face is very low, the biparietal diameter may not have passed the brim. This apparent deception is because the distance between the biparietal diameter and the face is double the distance between the biparietal diameter and the vertex. After satisfying that the head has come into the cavity, the whole hand is passed in the vagina so that the palm lies over the face and the fingers below the chin. The fingers now press on the chin so that the head is fully extended. Maintaining the extension, the palm is rotated to bring the chin forward. An attempt is made to rotate the shoulders simultaneously by abdominal manipulation. When the chin has been brought forward, the hand maintains it in position, while the blades of the forceps are applied. Easy locking of the blades indicates a satisfactory rotation. Traction is at first downwards and backwards so that extension of the chin is maintained until it reaches the subpubic region. Now the direction of traction is gradually changed to downwards and then forwards to effect flexion of the head so that the face, vertex and the occiput are born in succession.

Conversion into Vertex Presentation. Formerly, textbooks advised that whenever face presentation was diagnosed early in labour, an attempt be made to convert it into a vertex presentation. Conversion has definitely no place in mento-anterior positions as spontaneous delivery is the rule. As more than half the cases of mento-posterior rotate forward and deliver spontaneously, con-

version has hardly any place in the management. Besides, during conversion a face presentation may be converted into the unfavourable brow presentation.

Management of Emergency Cases. A number of cases are admitted after labour has been prolonged, and the face is impacted in the pelvis. Rarely, such cases are of mento-anterior positions and, irrespective of the condition of the foetus, delivery by forceps is generally successful. Most of the impacted cases are, however, of mento-posterior and mento-transverse positions. Generally, the foetal heart sounds are absent or very feeble, and the question of caesarean section does not arise, but should the foetal heart sounds be good, a tentative attempt at manual rotation and forceps should be made, failing which a caesarean section should be done. Craniotomy is obviously the only choice when the foetus is already dead or moribund.

Internal Version. Internal version has been suggested as an alternative method of delivery in a face presentation but, in our opinion, it has no place at all. Firstly, when a face presentation is diagnosed early in labour, it should be strictly left alone. When it is diagnosed late in labour, internal version is hazardous because by then the uterus has tightly gripped the foetus.

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CHAPTER 5

BROW PRESENTATION

When the attitude of the head is midway between complete flexion and complete extension, it is called brow presentation. Of all the cephalic presentations, it is the most unfavourable because the head has to engage in the longest diameter, mento-vertical, which measures $5\frac{1}{2}$ inches. As a rule, the head remains high above the pelvic brim and, if it remains undiagnosed until late in labour, it becomes dangerous both to the mother and the foetus.

Incidence. At the N.W.M. Hospital, Bombay, there were 24 cases of brow presentation in 43,842 viable confinements during the 5-year period of 1954 to 1960, an incidence of 1 in 1826 confinements.

Etiology. The etiology of brow presentation is almost identical to that of face presentation and consists of factors which interfere with flexion of the head or prevent its extension. Pelvic contraction is an important etiological factor and should always be looked out for in all cases of brow presentation. In recent years, increasing attention is being focused on the excessive extensor tone of the muscles of the back and the neck of the foetus as an etiological factor. A taut loop of cord round the neck may prevent flexion of the head and give rise to brow presentation. Premature foetus, twin pregnancy and dolicocephaly are some of the other etiological factors.

Diagnosis. During Pregnancy. Brow presentation cannot be diagnosed during pregnancy by abdominal palpation or vaginal examination. It is, sometimes, accidentally diagnosed by radiological examination undertaken for cephalopelvic disproportion.

During Labour. As membranes usually rupture early and the head is floating, a vaginal examination is generally made to exclude prolapse of the cord. If the dilatation is only one or two fingers, there is suspicion of a face or a brow presentation but, when the cervix is half dilated, a positive diagnosis of brow presentation can be made by finding the supra-orbital ridges on one side and the anterior fontanelle on the other side.

In neglected cases arriving late in labour, an extensive caput succedaneum obliterates the bony landmarks and it is only during

examination under anaesthesia that a diagnosis can be made by feeling the other landmarks of the face (Fig. 71).



Fig. 71. Brow presentation with moulding.

Mechanism. As brow presentation generally offers an insuperable obstruction during labour, there is no normal mechanism to consider. Occasionally, when uterine contractions are strong, the pelvis normal and the chin anterior, a small head may descend and a spontaneous delivery occur. The superior maxilla gets fixed against the pubis and, by a movement of flexion, the forehead, vertex and occiput are born and then by extension the face comes out of the vulva. Such an outcome is accidentally detected when the presenting part appears at the vulva and also from the nature of moulding of the delivered head.

Management. Hospital Cases. Brow presentation is seldom accurately diagnosed until the cervix is half dilated. The management usually resolves into, either correction of the brow into a vertex or a face, or delivery by caesarean section.

In primigravidae and multigravidae with an unfavourable past obstetric history, some degree of pelvic contraction is the underlying cause. These cases upto the stage when brow presentation is diagnosed by vaginal palpation are usually undergoing a trial of labour and, once brow presentation is diagnosed in them, trial

of labour must stop and preparations for an immediate caesarean section must be made.

In multigravidae with previous full-term spontaneous deliveries, manual correction into a vertex should be considered. The greater the dilatation of the cervix, the more likely is the success of the manipulations. As a rule, the membranes rupture early, and it should be carefully considered as to whether manual correction into a vertex should be attempted through a partially dilated cervix or one should wait for almost full dilatation. When the membranes are intact, one should wait for fuller dilatation. The manipulations are carried out under full anaesthesia. The head is grasped by the internal hand and, during relaxation, flexion is attempted, assisted by the external hand. After conversion, forceps should be applied if the cervix is fully dilated. The head at this stage is high up at the brim but, in multigravidae, slow traction with the head maintained in flexion by the forceps, is generally successful. If the cervix is not fully dilated, after conversion the flexion is maintained by applying Willett's forceps to the scalp, with continuous traction.

To convert a brow into a face by increasing extension may, sometimes, be preferred but only when it can be converted into a mento-anterior position. In an occasional case, internal podalic version may be resorted to in a multipara with a good obstetric history and the membranes recently ruptured.

Neglected Cases. When labour has been prolonged, an extensive caput succedaneum forms. The foetus is dead or moribund and perforation of the head alone may suffice, or crushing of the perforated head may have to be done to deliver the foetus. In a recent case at the N.W.M. Hospital, Bombay, the pelvis was so much contracted that it was not possible to deliver the head even after craniotomy and, eventually, a caesarean section had to be performed.

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CHAPTER 6

OBLIQUE OR TRANSVERSE LIE

(Shoulder Presentation)

In the majority of cases, the lie of the foetus is oblique with the head in one iliac fossa and the breech on the opposite side at a higher level. In only a few, the lie is transverse, that is directly across the long axis of the uterus. In most cases, the shoulder lies over the internal os and it is, therefore, called shoulder presentation.

Positions. Depending on whether the back is anterior or posterior and whether the head is to the right or to the left, there are four positions of transverse lie, viz. left dorso-anterior, right dorso-anterior, right dorso-posterior, and left dorso-posterior (Figs. 72, 73, 74, 75). Dorso-anterior positions are much more common than



Fig. 72. Head to left, back anterior.



Fig. 73. Head to right, back anterior.

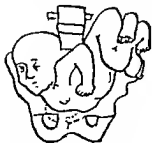


Fig. 74. Head to right, back posterior.



Fig. 75. Head to left, back posterior.

dorso-posterior because the ventral aspect of the foetus accommodates itself better to the curvature of the spines so that the foetal attitude of flexion is maintained.

As there is no mechanism of labour in shoulder presentation, a neglected shoulder presentation is one of the most dangerous complications of labour, and results in rupture of the uterus. The foetus invariably dies from asphyxia due to prolonged uterine retraction.

Rarely is there spontaneous delivery and that too only with a very premature or macerated foetus. One should never expect a natural termination with a full-term foetus. The two modes of natural termination are: *spontaneous expulsion* and *spontaneous evolution*.

In *spontaneous expulsion*, the foetus becomes doubled up. The back is expelled first and then the feet and the head are born together. It can be easily realised that such an extensive doubling up of the foetus can only be expected in a small macerated foetus.

In *spontaneous evolution*, there is considerable stretching of the neck. The breech is forced down the back of the pelvic cavity and the foetus is born as in a breech presentation (Figs. 76, 77).

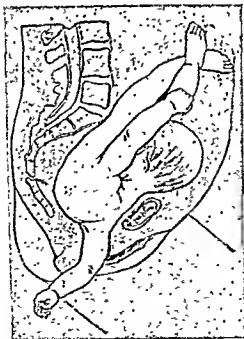


Fig. 76. Spontaneous evolution, first stage.

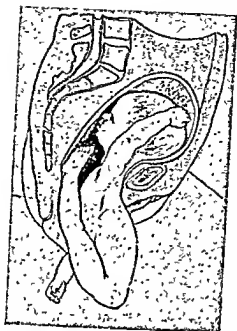


Fig. 77. Spontaneous evolution, last stage.

Incidence. The incidence quoted by various authors varies between 1 in 150 and 1 in 400. At the N.W.M. Hospital, there were 217 cases during a 5-year period, 1954 to 1958, giving an incidence of 1 in 202. It is much more common in multigravidae than in primigravidae. It is more common in premature labours than in full-term deliveries.

Etiology. Frequency of oblique presentations in multigravidae is due to the considerable oblique position of the uterus permitted by the weak abdominal muscles. Actually, the foetus is in the long axis of the uterine cavity, but, as a result of the oblique position of the long axis of the uterus, the head is directed towards one iliac fossa and the breech to the opposite lateral side. This is one factor which is present in more than half the cases. An additional factor for transverse lie in a multigravida is a large flabby uterus.

Persistence of the oblique lie after the 32nd week in primigravidae needs full investigation. A contracted pelvis should be excluded by a vaginal examination and, when necessary, by X-ray pelvimetry.

Whenever a transverse lie recurs after version, soft tissue

radiography should be employed to locate the site of the placenta, as placenta praevia is a likely cause.

In some cases of hydramnios, a transverse lie is found but, owing to large available space, the lie goes on changing from time to time during pregnancy. Following rupture of the membranes, there is a sudden rush of liquor amnii and transverse lie is much more likely to occur.

In twin pregnancy, one or both the foetuses may be in transverse lie. Sometimes, the second foetus, which was previously lying in a vertical axis, may become transverse immediately after the birth of the first one.

Sometimes, a uterus subseptus is the cause of transverse lie, Whenever external version fails to convert it into a vertical lie, or there is a history of transverse lie in previous pregnancies, a subseptate uterus should be suspected.

A pelvic tumour may, occasionally, be responsible for a transverse lie.

A transverse lie before the 28th week is due to prematurity and needs no comment.

In the rare cases of advanced abdominal pregnancy, the foetus is mostly in the oblique lie.

Diagnosis. During Later Months of Pregnancy. In multigravidae, there is usually no difficulty in diagnosing an oblique or a transverse lie through the loose abdominal wall, but, in primigravidae with firm abdominal muscles, it is not always easy. The shape of the abdomen, broad in the transverse axis or asymmetrical and broad in one flank, at once draws attention. The uterus, broad in the transverse axis, is aptly described as a 'squat' uterus. The head is felt in one iliac fossa and, on the opposite side, at a somewhat higher level, the breech is palpated. By the pelvic grip neither head nor breech can be palpated. When the limbs are palpated across the abdomen, it can be concluded that the back is posterior. There is no particular location of the heart sounds, but they are better heard when the back is anterior.

When palpation is not conclusive, a vaginal examination aids diagnosis in a negative way. The pelvis is found to be empty and, thus, a deeply engaged head or breech is excluded. In doubtful cases, a radiogram is necessary to diagnose the position.

Early in Labour with Membranes Intact. Abdominal palpation would be as described above. On vaginal examination, a banana-shaped, elongated bag of waters may be felt. An ill-de-

finer, irregular presenting part is felt above the pelvic brim, but palpation should be very gentle to keep the unsupported bag of waters intact.

Late in Labour. Abdominal palpation is very difficult and usually inconclusive because, the liquor amnii having drained away, the uterus is firmly applied to the body of the foetus. The uterine muscle is in marked tonus and does not relax in between contractions. The uterus may also be tender on palpation. All these factors prevent the location of the different part of the foetus. Frequently, the excessive stretching of the lower uterine segment is indicated by the retraction ring running obliquely across the abdominal wall, as a furrow, almost at the level of the umbilicus. Diagnosis now depends on vaginal examination only.

When an arm has prolapsed and is seen outside the vulva diagnosis of a neglected shoulder presentation is settled at once. By supinating the hand, the thumb points towards the head, and the palm indicates the ventral aspect of the foetus. When the hand is in the cervix or upper vagina it has to be differentiated from a foot. The most useful and certain guide to this differentiation is the presence of heel in the case of the foot and the thumb away from the other fingers in the case of a hand (Figs. 78, 79).

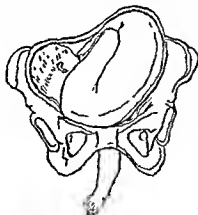


Fig. 78. Dorso anterior presentation with prolapse of the arm.

When the arm has not prolapsed, the wedged shoulder with the acromion process and the clavicle may be the lowest part but, in other cases, the ribs with the intercostal spaces in dorso-posterior position and the vertebral spines, and the angle of the scapula in dorso-anterior positions are palpated. By following the intercostal spaces, the fingers can be passed into the pit of the axilla. The

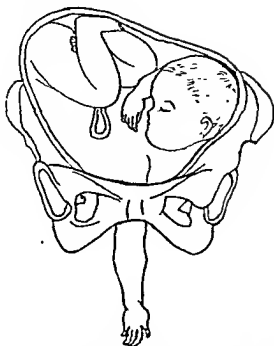


Fig. 79. Dorso posterior presentation with prolapse of the arm.

head lies on the same side as the axillary pit. In some cases, even the clavicle can be identified. It should be remembered that the shoulder feels as an irregular mass without any orifice or sutures.

Management. During Pregnancy. Discovery of a shoulder presentation before the 28th week is not of any clinical significance, and should be left uncorrected. Whenever a shoulder presentation is met with after the 32nd week, it should be corrected by external version.

In multigravidae, the obliquity of the uterus is first corrected and then, by gentle manipulations, the head can be brought over the pelvic brim. If the head can now be pushed into the pelvic cavity, no further measures are needed, but, if it remains above the pelvic brim, the uterus is maintained in the centre by applying lateral pads and a binder for a few days.

In primigravidae, pelvic contraction should be ascertained by external pelvimetry and a vaginal examination. If necessary, an X-ray pelvimetry should also be carried out. A soft tissue placentography, to locate the site of the placenta, is also advisable as placenta praevia may be the cause of shoulder presentation. If pelvic contraction is excluded, external cephalic version should be performed.

A transverse lie, which cannot be maintained in the corrected position during external version, arouses a suspicion of a subsep-

tate uterus. A repeated transverse lie in successive pregnancies is suggestive of contracted pelvis or a subseptate uterus.

Contraindications to External Cephalic Version. It should not be attempted if there has been a bout of antepartum haemorrhage. In the presence of a scar of a previous caesarean section, the advisability of practising version should be carefully reviewed. External version has no place in a case of contracted pelvis which, in any case, necessitates an abdominal delivery.

In any case, if the transverse lie recurs after performing version on two occasions, it should be left alone. The patient should be hospitalized several weeks prior to term.

Early in Labour. (a) *Membranes Intact.* Shoulder presentation diagnosed early in labour, with the membranes intact, is treated by external version. If the corrected lie of the foetus is easily maintained by lateral pads and a binder, labour should be allowed to progress naturally.

When the corrected lie tends to become oblique after version, the membranes should be ruptured and the head pushed into the pelvic cavity by suprapubic pressure. If an external podalic version has been performed, a foot is brought down into the vagina so that there is no chance for the lie to change.

(b) *Membranes Recently Ruptured.* In *multigravidae*, external cephalic or podalic version is done. With the background of previous normal deliveries, spontaneous delivery is to be expected. If external version cannot be performed then internal podalic version should be done if the pelvis is normal. After a podalic version, the further course of delivery will depend on the dilatation of cervix. When the cervix is partially dilated it is prudent to wait for full dilatation of cervix. Even when the cervix is fully dilated, spontaneous delivery should be aimed at and breech extraction carried out only when foetal distress demands it.

In *primigravidae*, external cephalic version should be performed, and cephalopelvic disproportion is estimated by Purandare's or Muller's method. With slight overlapping of the head, a trial of labour is given.

A caesarean section is necessary when there is marked cephalopelvic disproportion, or prolapse of the cord and in an elderly *primigravidae*, or in a *multigravida* with bad obstetric history.

Management of Neglected Cases. These are usually emergency admissions. The liquor amnii has completely drained away and the uterus is either tonically contracted or is not completely re-

laxing between contractions. A retraction ring, at or just below the umbilicus, is seen as a furrow obliquely across the abdomen.

On vaginal examination, the cervix is seldom more than half dilated. It is thick and oedematous. The arm is almost invariably prolapsed and, in some, the cord is also prolapsed (Figs. 75, 76).

The immediate risk is rupture of the overdistended lower uterine segment and, therefore, delivery with the least possible disturbance must be effected.

Hospital Cases. When the uterus has retracted firmly over the body of the foetus, an external or internal podalic version is not only impracticable but also dangerous to the mother, as the distended lower uterine segment is liable to rupture.

The immediate need is to prevent further overdistension of the lower uterine segment. In hospital practice, whenever there is excessive distension of the lower uterine segment as indicated by the high situation of the retraction ring and other local or general signs, caesarean section should be performed. Under cover of antibiotics, the safety of this operation in neglected cases has increased. In support of caesarean section it may be pointed out that, when the abdomen is opened, it frequently found that the lower uterine segment is on the point of rupture.

An alternative to caesarean section is decapitation, but it must be remembered that it is not always an easy procedure, and rupture of the uterus would be precipitated, in such extensively thinned out lower segment. In any case, if decapitation is successfully performed, the uterus must be manually explored so that if rupture is detected, immediate laparotomy can be performed.

Cases Treated Outside Hospital. There is no alternative but to do decapitation and to explore the uterus afterwards for possible rupture. In rural areas, persons well trained in obstetrics are not, as a rule, available and the technically difficult operation of decapitation, without proper anaesthesia and non-availability of blood, carries great hazards for the mother. If rupture is detected, the best that can be done is to pack the uterus and persevere with the treatment of shock. The mortality is evidently very high but this is all that can be done.

Prognosis. Foetal. The prognosis for the foetus depends on the stage of labour at which the patient first comes under treatment. Cases which have been observed from the later weeks of pregnancy bear a favourable prognosis as a well-planned line of treatment is carried out in an institution. Under these conditions,

the foetal loss should not be any more or only slightly greater than in normal cases.

The prognosis is always serious when the case is seen late in labour, because prolonged retraction of the uterus, following premature rupture of the membranes, causes foetal death from asphyxia. In most of the cases seen at this stage, the foetus is already dead or moribund.

Maternal. Prognosis to the mother is also unfavourable in neglected cases of transverse lie. Rupture of the uterus is a grave complication and carries a high mortality. Obstetric shock, as a result of prolonged labour, difficult intra-uterine manipulations and sepsis, all add to the seriousness of the condition.

CHAPTER 7

BREECH PRESENTATION

Although breech presentation is described as an abnormal presentation, it generally has an uncomplicated course. Apart from a slightly higher incidence of trauma to the birth canal, there is no other disadvantage to the mother. Its main disadvantage over cephalic presentation is the increased foetal death rate. When a comprehensive figure of foetal deaths of cases of breech, (a) complicated by some additional obstetric abnormality, (b) attended in a hospital by junior resident staff, and (c) delivered prematurely, is taken, the foetal death-rate is considerable, 10 to 20 per cent; but, when a separate figure for uncomplicated full-term cases is taken, the foetal death-rate is as low as 2 to 3 per cent.

Incidence. During the 3-year period, 1959-1961, 774 cases of breech presentation were delivered at the N.W.M. Hospital, Bombay, while there were 27,649 viable births. This gives an incidence of 2.8 per cent.

Table

Parity	Complete breech	Breech with extended legs (Frank breech)	Footling	Total
Primipara	93	71	60	224
Multipara	341	103	106	550
Total	434	174	166	774

Above table gives the analysis of these 774 cases according to parity and the type of breech. In primiparae, 29 per cent were breech with extended legs as against 18.7 per cent in the multiparae.

Breech with extended legs occurs more commonly in primiparae, whereas complete breech occurs more commonly in multiparae.

Varieties. The two common presentations are: the *fully flexed breech* (Fig. 80) and the "*frank breech*" (Fig. 81). Of the other



Fig. 80. Fully flexed breech.



Fig. 81. Breech with extended legs (frank breech).

two, the footling and the knee, the footling is more frequent than the knee.

In the fully flexed or "complete" breech, the presenting part consists of two buttocks and two feet.

Frank breech is commonly called breech with extended legs because the presenting part consists of two buttocks, the lower limbs flexed at the thighs and extended at the knees lying alongside the body.

In knee presentation, the legs remain flexed but the thighs become extended.

In footling presentation, both the legs and the thighs are extended so that the feet present.

The position of the back remains the same as in corresponding vertex presentations, but the denominator is the sacrum. As the situation of the sacrum like the occiput is on the same side as the back, the four positions of breech are:

- 1st. Left sacro-anterior (L.S.A.), sacrum opposite the left iliopectineal eminence (Fig. 82).
- 2nd. Right sacro-anterior (R.S.A.), sacrum opposite the right iliopectineal eminence (Fig. 83).
- 3rd. Right sacro-posterior (R.S.P.), sacrum opposite the right sacro-iliac joint (Fig. 84).
- 4th. Left sacro-posterior (L.S.P.), sacrum opposite the left sacro-iliac joint (Fig. 85).

Etiology. The conventionally mentioned etiological factors, such as contracted pelvis, placenta praevia, pelvic tumours, hydramnios, twins and foetal abnormality, have undergone a critical

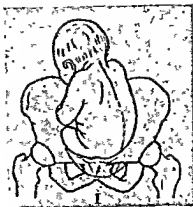


Fig. 82. Breech, left sacro-anterior position.

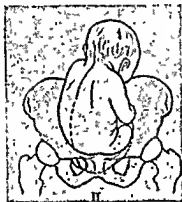


Fig. 83. Breech, right sacro-anterior position.



Fig. 84. Breech, right sacro-posterior position.



Fig. 85. Breech, left sacro-posterior position.

review in recent years. Contracted pelvis has now become much less frequent, yet the incidence of breech has remained undiminished. The occurrence of breech presentation in cases of placenta praevia is about 2-3%, which is more or less the same as the incidence of breech in total viable births. Pelvic tumours are so rare that they hardly need any mention. In twin pregnancy, the first or the second foetus delivers as breech, but that depends on the available space in the uterus. Both foetuses presenting by the breech is a relatively rare combination. Spontaneous version occurs in the majority of cases of complete breech by the 32nd week and therefore deliveries occurring before the 30th week would necessarily have a higher incidence of breech presentation as compared to full term deliveries.

Breech with extended legs appears to be a primary foetal attitude due to excessive muscular tone in the foetus. Spontaneous version does not often occur by the 32nd week in these cases, because the small conical breech enters the pelvis and prevents spontaneous version. Too little liquor may also be a contributory factor. Breech with extended legs is, therefore, primarily due to increased muscular tone of the foetus and the position is maintained by early engagement of the breech and scanty liquor amnii.

It has been suggested by Stevenson that cornu-fundal implantation of the placenta encroaches on the upper part of the uterine cavity so that the small head is better accommodated at the fundus. By radiological method, Whitehead demonstrated cornual implantation in 50% of his 187 cases.

Diagnosis. Inspection. In a case of breech with extended legs, as the fundus is broader than the lower pole, the uterus is like an

inverted pear. In complete breech presentation, the lower pole is broader. These alterations in the shape are not so marked as to draw immediate attention, and the accoucheur usually notices the altered shape after he has diagnosed breech presentation by abdominal palpation.

Palpation. In a case of complete breech presentation, the head is palpated at the fundus as a round, hard and easily ballotable mass. The head is palpated more often under one or other costal arch and, less frequently, in the centre. At the lower pole, the breech is felt as a broad, soft and irregular mass. In both, primigravidae and multigravidae, a complete breech remains above the pelvic brim until the onset of labour.

A breech with extended legs is not always easy to diagnose by abdominal palpation. This difficulty is particularly noted in primigravidae who have tight abdominal wall. In a complete breech presentation, palpation of the head at the fundus is conclusive, but, in the case of breech with extended legs, the outline of the globular head and its ballotment are obscured by the feet lying alongside the head. Neither is the palpation of the lower pole helpful, because, several weeks before term, the small, conical breech engages deeply and is frequently mistaken for a head well down in the pelvis. It is the inconclusive abdominal palpation that necessitates a vaginal examination and, when that is also inconclusive, an X-ray examination has to be undertaken. Besides confirming the diagnosis of breech presentation, X-ray examination also diagnoses: (1) the variety of breech, (2) unsuspected multiple pregnancy, (3) foetal monstrosity, and (4) pelvic contraction. In a complete breech, the limbs are palpated on one side or all over the front of the abdomen when the back is posterior. In a breech with extended legs, the upper limbs are tucked between the thorax of the foetus and its extended legs so that limbs are palpated with difficulty or, frequently, not at all.

Auscultation: The foetal heart sounds are heard above the umbilicus when breech is floating, but at or below the umbilicus when breech is engaged.

By vaginal examination, a complete breech is palpated as an irregular mass high up at the brim and, if the cervix is patulous, one or both the feet may be felt through it. A frank breech, on vaginal examination, is likely to be mistaken for a head, because it also has a regular shape. Absence of ballotment is conclusive

of its being a breech. When a fontanelle or a suture is palpated through a patulous cervix, breech is definitely excluded.

After labour has been in progress for some time, the breech is easily identified by vaginal examination. The buttocks, the anus and the feet can be felt. Sometimes, the scrotum can also be felt in a male foetus. During labour, a face, especially when oedematous, may be mistaken for breech.

Mechanism. The engaging diameter of the breech is bi-trochanteric, 10 cms. which, in the first breech, engages in the left oblique diameter. As the breech descends, there is internal rotation of the left buttock to the front so that it comes to lie behind the symphysis pubis, and the bi-trochanteric diameter is in the antero-posterior diameter of the pelvic cavity, the back facing directly to the left. As the breech descends further down, the trunk of the foetus undergoes lateral flexion. With further descent, the posterior buttock negotiates the long posterior vaginal wall. The anterior buttock moves very little along the short anterior vaginal wall (Figs. 86, 87, 88).



Fig. 86. Breech descended into the pelvic cavity. Figs. 87 & 88. Lateral flexion of the breech in the pelvic cavity.

The anterior buttock appears at the vulva and is born first, followed by the posterior buttock. As the buttocks are being born, the bisacromial diameter (11 cms.) engages in the left oblique diameter of the brim. The abdomen, with the flexed lower limbs over it, is born. The chest then passes through the pelvic cavity. The shoulders undergo internal rotation like the breech bringing the left or anterior shoulder under the symphysis. The arms are born flexed over the chest. The left shoulder and the left arm escape from under the symphysis, and the right shoulder and the right arm over the perineum.

The head is now in the lower part of the uterine cavity and

engages in the transverse diameter of the brim. The occiput rotates to the front and the head escapes from the cervix and lies in the vagina in the mid-cavity. As the occiput rotates to the front, the back of the foetus also comes forward from its left lateral position. The sagittal suture is now in antero-posterior diameter and the face is applied to the posterior wall of the birth canal. Upto the time the head leaves the cervix, uterine contractions as well as bearing down efforts help expulsion of the foetus. Once the head has descended into the vagina, further descent is by the bearing down efforts on the part of the patient assisted by gentle traction by the attendant. As the occiput appears underneath the symphysis pubis, the nape of the neck lies under the sub-pubic angle which acts as a fulcrum and, by forward lifting of the trunk, the face, the brow and the vertex are delivered in succession.

In the 3rd and 4th positions of the breech, the mechanism is slightly different. In left sacro-posterior position, the bi-trochanteric diameter enters the pelvis in the right oblique diameter. The left buttock rotates forward to lie behind the symphysis pubis. The shoulders also engage in the right oblique diameter of the brim. The movements of the trunk and the head are as described in the previous paragraph.

Management of Breech during Pregnancy. In view of the high foetal mortality, it is preferable to convert the presentation to vertex by an external version. Before the 28th week, breech presentation is common, the incidence being as high as 20% but between the 28th and the 34th week, spontaneous version occurs in many cases of complete breech. Spontaneous version is less likely in breech with extended legs.

External Version. Optimum Time. There is no doubt that spontaneous version frequently occurs between the 28th and the 34th week, but it is the author's practice to perform version soon after the 30th week. Version should not be delayed till the end of the 34th week for the following reasons: Breech with extended legs is difficult to turn into vertex but early attempts at version at the 30th week, when the foetus is comparatively small and the breech is not deeply engaged, are more likely to be successful. As breech with extended legs occurs frequently in primigravidae in whom the tight abdominal wall does not allow easy turning, the earlier the version is done, the greater the likelihood of its success. Much less force will be required to turn the small foetus at the 30th week and, therefore, the chances of premature separation of the placenta

and premature labour are less. Even if it becomes a breech again, a second correction can be carried out a week later.

External version is done in the antenatal department; but if it fails, the second attempt should be made a couple of days later by a senior experienced person after admitting the patient into the hospital. An aperient is preferably given a day before. If the second attempt fails, the question of doing the version under anaesthesia and aided by relaxant drugs arises. Version under anaesthesia must be done by an experienced person as undue force by an inexperienced person is likely to produce undesirable complications. External version under anaesthesia should only be undertaken if (1) version without anaesthesia has failed only due to the resistance of the abdominal muscles, and (2) there is border line pelvic contraction. Here assessment of cephalopelvic disproportion is of great value.

Hazards of External Version. It must be remembered that external version carries some risk with it, especially when done under anaesthesia. In fact, it carries 1-2 per cent foetal mortality. The main hazards of external version are: (1) Rupture of membranes and premature labour (it is rare and if after 36 weeks is not serious); (2) separation of the placenta (if placenta is situated on the anterior uterine wall or undue force is used); (3) intra-uterine foetal deaths (cord may get knotted or even torn); (4) cord prolapse (the risk is greater if complete breech persists); (5) compound presentation (rarely, breech with extended legs may become head and foot presentation); and (6) rupture of the uterus (if done under anaesthesia or in the presence of a uterine scar).

Contraindications. (1) In cases of pre-eclampsia and essential hypertension, version may precipitate accidental haemorrhage. (2) Version should not be attempted in cases of placenta praevia or accidental haemorrhage. (3) In the presence of a previous caesarean scar, version should not be attempted. (4) It should not be done in cases of hydrocephalus or twins. (5) In the presence of gross pelvic contraction, version is superfluous.

Management of Breech Labour. The First Stage. The management of the first stage is similar in a complete breech and in breech with extended legs, but there are certain differences which need attention. In a complete breech, the first stage is prolonged because the membranes tend to rupture before full dilatation of the cervix, and further dilatation is dependent on the pressure of the broad irregular breech. On the other hand, the first stage in a

breech with extended legs tends to be short, because the conical, regular breech acts as a good dilator. Another difference between the two varieties of breech presentation is that the low lying, unsupported cord in a complete breech is likely to prolapse when the membranes rupture. In breech with extended legs, the cord lies well supported between the abdomen and the extended legs, and prolapse of the cord rarely occurs.

It is advisable to keep the patient lying down throughout the first stage, particularly when the breech is not engaged, as prolapse of the cord is almost certain to occur should the membranes rupture in a standing position. Sedatives should be given to allay the anxiety during the long wait for the cervix to dilate. An injection of 100 mg. of pethidine is best, and it can be repeated after 4 to 6 hours, as half or full dose, as necessary. A vaginal examination should be made early in labour to note the dilatation of the cervix, the descent of the breech, to detect the presentation of the cord and to assess the bony pelvis. In any case, a vaginal examination must be made immediately after the membranes rupture for excluding prolapse of the cord. During the first stage, meconium is often passed, but that is due to the pressure on the abdomen and is therefore not a sign of foetal distress.

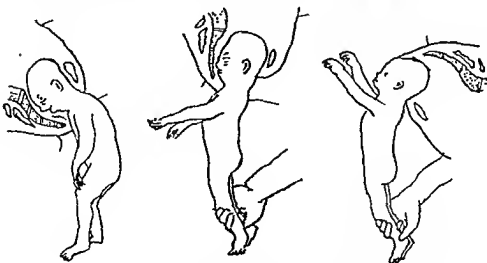
The Second Stage. As the breech begins to distend the perineum, it is advisable to carry out pudendal nerve block anaesthesia and also infiltrate the perineum. In all breech deliveries, minor manipulations are required and, as so much depends on the co-operation of the patient in bearing down efforts, a local anaesthesia in the perineal region is necessary. A generous episiotomy is performed in all primigravidae and it is advisable in many multigravidae. The patient is brought to the edge of the delivery bed and her legs are held by an assistant on either side or by suitable supports.

As the buttocks crown, the fingers are slipped into the vagina by the side of the buttocks and, if the feet are felt, each foot is guided out. After the birth of the buttocks and the feet, the cord is felt and a loop is drawn down (Figs. 89, 90,). The object of drawing down the loop of the cord is to feel its pulsations. Again if a loop is not brought down, it may be so stretched that it may tear away at the umbilicus. After the feet are born the baby is held as shown in Fig. 91. The foetal trunk should now be wrapped in a warm towel to guard against external stimuli triggering off respiratory attempts. In a frank breech, the extended legs

remain pressed by the side of the body, and should be left undisturbed until the popliteal region is born. Now, by hooking a finger over the shin of the tibia, each leg is brought out.

As mentioned above, the attendant must depend for delivery of the body on the bearing down efforts of the patient, and must refrain from traction on the feet. It is advisable to supplement the force of uterine contractions by asking an assistant to exert pressure on the fundus. With the next pain, the thorax appears at the vulva and, when the angles of the scapulae are seen, the feet are lifted forward and the hand is passed by the side of the chest to help the delivery of the posterior shoulder. Similarly, by pulling the trunk downwards the anterior shoulder is delivered.

No sooner both the arms are delivered, the back is rotated to the front. It is at this stage that the operator tends to hurry the delivery of the head. But, it must be remembered that more babies are either stillborn or die later from intracranial injury, because the attendant becomes panicky, than by deliberate waiting for the head to descend into the pelvic cavity by its own weight. The Burns-Marshall method for the delivery of the head is useful. The head of the foetus is encouraged to descend into the pelvic cavity by letting the body hang from the vulva for one or two minutes so that the weight of the foetus helps descent of the head and keeps the head in a flexed position. When the sub-occipital region comes beneath the subpubic angle, the foetus is held by the ankles and is lifted forward towards the mother's abdomen, making sure that the body is not twisted at the nape of the neck (Figs. 92, 93, 94).



Figs. 92, 93 & 94. Burns-Marshall method of delivery of the after-coming head.

By the other hand, the escape of the head from the vulva is controlled. Throughout the delivery of the head, firm fundal pressure must be exerted to help descent and to keep flexion of the head.

Management of Complicated Breech Labour

In spite of the fact that over 90 per cent of breech presentations deliver normally with minimal assistance the remaining require interference if there is any delay in the birth of the breech, shoulders or the after-coming head.

Arrest of Breech. The breech, like the head, may be arrested at the brim or in any part of the pelvis below it. When the breech has descended to a level below the ischial spines, assisted vaginal delivery is the rule, but the problem is complicated when it is arrested at a higher level.

Arrest below Mid-cavity. When there is delay in the birth of breech which has descended to the pelvic floor, it is due to ineffective uterine contractions or rigidity of the perineum, or an outlet contraction. A generous episiotomy is of considerable help and, should the presentation be a complete breech, the feet can be easily reached and the legs are brought down.

A breech with extended legs, when it has descended so low, very rarely causes delay. The delay is said to be due to prevention of lateral flexion of the body but pulling down a leg is very seldom required in breech with extended legs at this level.

Arrest above Mid-cavity. When the breech is arrested at the brim or at any level above the ischial spines, the problem of management is similar in many respects to trial labour in a vertex presentation.

Elective caesarean section or caesarean section early in labour is indicated in all primigravidae above the age of 35, and in multigravidae with a previous bad obstetric history.

When cord prolapses early in labour with the cervix less than half dilated, a caesarean section is the method of choice.

Young primigravidae and multigravidae with previous good obstetric history should be carefully watched until rupture of the membranes. Frequently, soon after rupture of the membranes when the uterine contractions improve, a hitherto stationary breech rapidly descends.

In a primigravida, when the breech fails to progress after rupture of the membranes, and more so in a breech with extended

legs, it is better to do a caesarean section. In such cases, there is, most likely a slight pelvic contraction and, even if the legs can be successfully brought down, the after-coming head would meet with difficulty.

In a multigravida with previous good obstetric history, pelvic contraction can be ruled out. The delay is usually due to uterine inertia, and bringing down a leg should be considered.

Delay due to Extension of Arms. Primary extension of the arm is very rare. It is almost always *secondary* during the course of labour. In a large number of cases, extension of the arm results from traction applied to the buttocks. In some cases of breech with extended legs, the small breech comes out through an incompletely dilated cervix but, as the chest passes through it, the arms may be held up and get extended. A small premature foetus may deliver with the arm extended, but a full term average sized foetus will always need assistance to bring down the extended arms. When the delivery of the trunk does not progress beyond the costal arches, a hand passed along the ventral aspect of the chest will not find any part of the upper limbs.

Technique. As the arms are already extended, traction on the trunk can be made without any disadvantage and in fact firm traction, by holding the foetus by the ankles, must be made so that the shoulders and the extended arms come as low as possible. When the lower angle of the anterior scapula is seen, the posterior shoulder is in the sacral hollow. The foetus held taut by its legs is lifted forward to bring the posterior shoulder still further down. By passing the hand along the posterior vaginal wall, the posterior arm is brought down first. The hand passes over the shoulder along the humerus to the elbow. When the forearm is reached, the accoucheur sweeps the forearm across the face and the chest, from where it is brought down without difficulty (Fig. 95).

With the posterior arm delivered, there is more room and, as a rule, the anterior arm is brought down by holding the foetus backwards so that room is available for passing the hand between the symphysis pubis and the foetus. If the anterior arm cannot be brought down in this manner, it is first turned posterior by rotating the trunk of the foetus through two right angles. Rotation is made so that the back from its lateral position on one side first becomes posterior and then comes to be on the lateral aspect of the other side. This is very important because rotation in the opposite direction will bring the arm behind the neck. When the arm comes

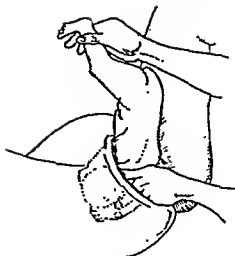


Fig. 95. Delivery of an arm extended by the side of the head.

to lie behind the neck, it is called "nuchal displacement" or "dorsal displacement" of the arm.

Nuchal Displacement of Arm. In this case, a long rotation of the trunk should be carried out in the direction that takes the head

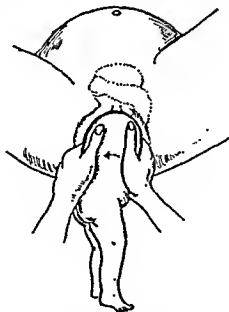


Fig. 96. Nuchal position of the arm.

away from the arm. The fingers of the nuchally displaced arm point to the direction of the rotation. Once the nuchal displacement is corrected, the extended arm should be delivered as described above (Figs. 96, 97).

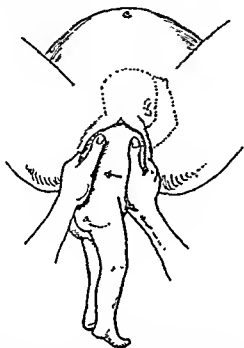


Fig. 97. Correction of the nuchal position of the arm.

Arrest of After-coming Head. In every breech delivery, the forceps should be ready at hand. Some use forceps as a routine for delivery of the after-coming head. The delay is either because there is incomplete dilatation of the cervix, incomplete flexion of the head or pelvic contraction. In many cases, firm suprapubic pressure helps to bring down the head low in the pelvic cavity but, should that not happen, forceps should be applied and the head delivered. In case of delay, the jaw and shoulder traction method of Mauriceau, Smellie, Viet has been recommended, but it is unwise to try these manoeuvres and then to decide to apply forceps. Forceps is such a safe and easy method that it should be used without hesitation when it appears that the head does not descend by the Burns-Marshall method.

Jaw and shoulder traction is a drastic method and vigorous traction frequently results in Erb's paralysis, haematoma of the sterno-mastoid, fracture of the clavicle or dislocation of the ver-

tebrae. No apology is made for omitting the description of this time-honoured method as it should now be considered as having outlived its time and is of academic interest only.

Backward rotation of the occiput will often cause arrest of the head at the brim. Backward rotation of the trunk would never occur, if the attending accoucheur is careful to correct immediately any tendency for backward rotation of the trunk, by holding the foetus at the pelvic girdle and rotating the trunk forward. If, however, the trunk and the head have already rotated backwards, the accoucheur has either to rotate the trunk forwards or to deliver the foetus in the occiput posterior position. If the arms have also been delivered, rotation forwards of the head is difficult because the uterus has already firmly contracted over the head, and all that the accoucheur achieves is twisting of the neck with serious injury to the cervical spines. While delivering the head as occiput posterior the child should be lifted forward towards the mother's abdomen so that the nape of the neck, occiput and vertex roll over the perineum while the root of the nose is fixed behind the pubis (Fig. 98). Rarely, the head may be extended and the chin caught at the pelvis. This also needs the same manoeuvre for delivery.

Breech Extraction. Occasionally, conditions may arise which may need rapid delivery of the foetus by traction on its legs. When the breech has already delivered and the pulsations in the cord suddenly become feeble, the rest of the trunk and the head is delivered by traction on the legs. Breech extraction is done under anaesthesia whenever the breech with extended legs is above the ischial spines.

Breech extraction should not be taken lightly and practised without an urgent indication to deliver the foetus quickly. It is likely to make delivery complicated by extension of the arms and intracranial trauma as a result of rapid delivery of the head. The foetal mortality in breech extraction is as much as 25 per cent, and though it is partly due to the already existing foetal distress, yet unwanted force for delivery also plays an important role in producing this high rate of mortality.

Technique. The patient is brought under full inhalation anaesthesia. If the breech is in the cavity it is pushed up above the pelvic brim. The hand is passed along the ventral aspect of the thigh to the popliteal fossa and as further up as is possible. The fingers are brought over the shin of the tibia and, by a downward pressure, the leg is gradually flexed and, when the ankle is reached,



Fig. 98. Delivery of the after-coming head in occiput posterior.

traction is made on it. In this manner, the leg is completely flexed and it is then brought down by gradual traction on the foot. The second leg is brought down in a similar manner.

If the cervix is not fully dilated when the legs are brought down, there will be difficulty in the delivery of the arms and the after-coming head. In a multipara, the cervix being more elastic and dilatable, there is not so great a difficulty as in a primigravida. It may, on rare occasions, be advisable to incise the cervix to effect rapid extraction in the interests of the foetus.

No sooner the lower angle of the scapula is seen, the arms, which are almost always extended due to traction on the breech, are brought down as described above. The after-coming head is delivered by forceps.

Management of Neglected Breech Presentation

Impacted Breech. When breech is impacted in the midcavity, delivery can be effected by bringing down the leg. In hospital practice, primigravidae should be delivered by caesarean section but, in multigravidae with previous good obstetric history, bringing down the leg is indicated.

Technique. It must be done under general anaesthesia. The patient is put in litotomy position and the hand is passed into the uterus along the ventral aspect of the foetus. If the breech is impacted, it is pushed up above the pelvic brim. Pinard, many years ago suggested that with the finger tips in the popliteal fossa the leg is partially flexed and, as the foot comes lower, it is more easily grasped (Fig. 99). In actual practice, however, Pinard's method is not easy to practise and it is better to pass the hand higher until the foot is reached. The ankle is then grasped between the index and the middle fingers and brought down.

When the uterus is tonically contracted, any intrauterine

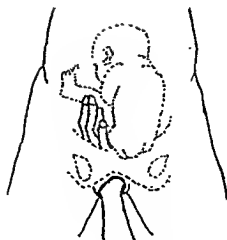


Fig. 99. Bringing down the leg.

manipulation is not only difficult but hazardous to the mother; the only method available is to deliver the breech by traction on the groin (Fig. 100). Traction by hooking the fingers is not possible

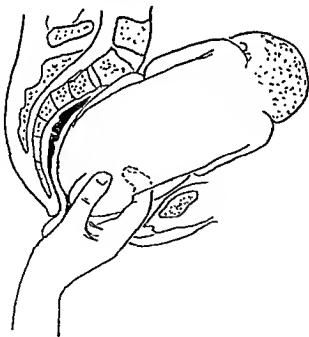


Fig. 100. Groin traction by a finger.

as the breech is impacted at a higher level and, even if it were possible, it is unlikely to succeed in delivering the breech. The dead or moribund foetus is of secondary importance and firm traction on groins by a tape passed over the groins or by a Braun's hook will succeed. A deep episiotomy is of course imperative (Fig. 101).



Fig. 101. Braun's hook for traction.

Arrest of Shoulders. When a breech has delivered but further progress has been arrested by extension of the arms, it may be possible to bring down the extended arms without anaesthesia; but when the uterus is tonically contracted, deep inhalation anaesthesia will be necessary to relax the cervix and the uterus.

Arrest of After-coming Head. This is frequently due to delivery of the breech through an incompletely dilated cervix, but a hydrocephalus may also be the cause. A hydrocephalus can be drained either by perforating the occipital region or, when the head is not accessible, by opening into the spinal canal of the already delivered trunk and passing through it gum elastic catheter into the cranium.

When the head is arrested by the incompletely dilated cervix, pethidine, 100 mg., is given intramuscularly and at the same time continuous traction is maintained on the trunk. The cervix will dilate in the course of the next few hours, and the head will slip out into the vagina. Should the head fail to deliver after full dilatation, a craniotomy will be required.

Perinatal Mortality. The gross perinatal mortality in the N.W.M. Hospital series was 30.8 per cent which is comparable to that of 32.5 per cent by Bbagat and Grover from another centre in India. These figures are higher than those in the West where the gross perinatal mortality is between 20 and 25 per cent. The corrected perinatal mortality in the N.W.M.H. series was 8 per cent. The corrected perinatal mortality is arrived by excluding all premature births as well as all cases of breech complicated by toxæmia, hydramnios, multiple pregnancy, malformations, cord prolapse, antepartum haemorrhage, maceration and Rhesus incompatibility.

Maternal Mortality. There was one death in the N.W.M.H. series due to cholaemia and hepatic failure, a complication having no association with breech delivery.

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CHAPTER 8

COMPOUND PRESENTATION

Prolapse of an extremity by the side of the presenting part is called a compound presentation. The commonest compound presentation is when there is an arm by the side of the head. Rarely, a foot or feet may be found by the side of the head. Goplerud and Eastman had 65 cases of compound presentation among 42,410 viable deliveries, an incidence of 1 in 652. The incidence of head and hand presentation was 1 in 744, of head and foot 1 in 7,068 and of breech and hand 1 in 10,602.

During pregnancy, a compound presentation is diagnosed accidentally by seeing it in an X-ray film. If the X-ray picture is taken several weeks prior to full term, the presenting limb will most likely resume its normal position as term approaches. In any case nothing can be done before the onset of labour to displace the limb upwards.

Head and Arm Presentation. It is likely that some of the cases pass unnoticed because, during labour, the head may continue to descend and leave the arm above it. It is usually diagnosed during labour when a vaginal examination is done for delay in the descent of the head (Fig. 102). When the cervix is almost fully dilated

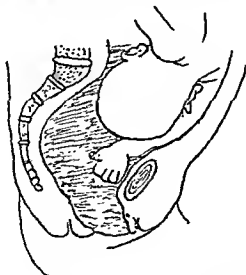


Fig. 102. Compound presentation — head and arm.

the arm can be pushed up easily even without anaesthesia but, when the cervix is partially dilated it will be necessary to give anaesthesia. The arm is pushed up in between uterine contractions. After pushing the arm up, the head is pressed down into the brim by suprapubic pressure.

Head and Foot Presentation. When both the feet are by the side of head, the position of the foetus is best described as "inverted breech with extended legs". In fact, the presentation may be the result of external version carried out in a case of breech with extended legs. The head cannot enter the brim and it is not easy to push the feet up. A case of "inverted breech with extended legs" is best treated by caesarean section. Alternatively, an internal podalic version may be performed by pushing the head up. Even if foetus is dead, one should resist the temptation of doing a craniotomy because even a perforated head cannot pass through the pelvis with the feet lying by its side and the trunk splinted by the extended legs.

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CHAPTER 9

PRESENTATION AND PROLAPSE OF UMBILICAL CORD

Definition. When one or more loops of the umbilical cord lie below the presenting part, it is called presentation of the cord. When, after the rupture of the membranes, the cord descends into the vagina, it is called prolapse of the cord. Cord prolapse may occur either as a sequence to cord presentation, or the cord may be washed down from its normal position with the escape of the liquor amnii.

Incidence. At the N.W.M. Hospital, Bombay, there were 97 cases of cord prolapse during the two years, 1956-57. During the same period there were 17,690 viable births, which gives the incidence of 1 in 182. As these cases of cord prolapse are often admitted as emergencies, the incidence is necessarily high in hospitals.

Cord prolapse is more common in multigravidae and in this series there were 81 multigravidae and 16 primigravidae, a ratio of 5:1. This high incidence in multigravidae is partly explained by the fact that the number of confinements in multigravidae is considerably higher than in primigravidae and partly because the presenting part in a multipara frequently does not engage until labour has been in progress for some time.

Etiology. Normally, the presenting part is closely applied to the lower uterine segment so that the bag of waters is divided into forewaters and hindwaters. Therefore, any condition which interferes with this close application of the presenting part to the lower uterine segment, allows communication between the fore and hind waters, and it is along the communicating space that the cord slips down either before or after the rupture of the membranes. The incidence of cord prolapse in different presentations in this series is tabulated below:

Vertex. It is revealing that 60% of cord prolapse occurred in vertex presentations. The high incidence in cephalic presentation is because more than 90% of presentations are cephalic. As the majority of these cases occurred in multiparae, early rupture of the membranes, with the head still at the brim, was responsible for this complication.

Year	Vertex	Breech	Trans- verse	Brow and Face	Vertex and hand	Placenta praevia	Total
1956	33	6	1	1	3	—	44
1957	25	9	8	1	8	2	53
Total	58	15	9	2	11	2	97
	59.79%	15.47%	9.23%	2.06%	11.34%	2.06%	

Face and Brow. During the two years there was a total of 108 cases of face and brow and there were only 2 cases of cord prolapse, which shows that face and brow presentations are not particularly likely to cause cord prolapse.

Breech. In 15 cases, cord prolapse was associated with breech presentation. All the cases occurred in either complete breech or footling presentation. Cord prolapse rarely occurs in breech with extended legs as the cord lies snugly between the legs and the abdomen. There was no case of cord prolapse in this variety of breech in this series.

Transverse. Although many cases of neglected shoulder presentation with prolapse of the arm were admitted, yet cord prolapse occurred in 9 cases only. In shoulder presentation, prolapse of the cord is more likely in dorso-posterior position with the ventral aspect of the foetus towards the cervix.

Vertex, Hand and Cord Prolapse. The frequent occurrence of cord prolapse in compound presentation is easily explained, but as in 6 of the cases there was premature labour, it is likely that a small foetus predisposes to this complication.

Placenta Praevia. There were 2 cases of cord prolapse and both were cases of lateral placenta praevia. In lateral placenta praevia, the cord lies very near the cervix, and prolapse following the rupture of the membranes can easily occur but, considering the total number of lateral placenta praevia, the incidence of cord prolapse is very low.

Hydramnios. In 6 cases of cord prolapse there was hydramnios. The sudden rush of liquor amnii following the rupture of membranes must have swept the cord down.

Malformations of Bony Pelvis. Before the advent of regular antenatal supervision, a contracted pelvis was the commonest cause of cord prolapse but regular antenatal and proper intranatal care has practically eliminated the danger of cord prolapse. In this series, there was only 1 case of cord prolapse in which a flat pelvis was associated.

Prematurity. The incidence of cord prolapse is relatively high in premature deliveries and in twin labours.

Diagnosis. The only way of diagnosing cord presentation or prolapse is by vaginal examination.

Presentation of Cord. As vaginal examination before rupture of the membranes is not done as a routine, a number of cases of presentation of the cord are obviously missed. For the same reason, it is not known how many cases of cord prolapse are secondary to cord presentation. It is usually accidentally diagnosed during vaginal examination of a case of cephalopelvic disproportion or malpresentation. Cord presentation should be particularly looked for in primiparae with floating head. If pulsations are absent, the cord can easily be mistaken for fingers or toes (Fig 103).

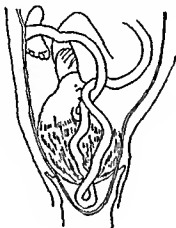


Fig. 103. Presentation of the umbilical cord.

Prolapse of the cord is obvious when a loop of it is seen at the vulva (Fig. 104). It should be anticipated in cases of hydramnios, trial labour, breech and transverse presentations, and a vaginal examination must be done soon after the membranes rupture. A cord may not prolapse but may lie alongside the head, occult prolapse, and the effects of compression are noticeable by an irregular and markedly slow heart rate during contractions. A cord lying alongside the head may be compressed during forceps extraction, and therefore, before applying the blades, its presence should always be borne in mind during the preliminary examination (Fig. 105).

Prophylaxis. Undoubtedly, many cases of cord prolapse result from presentation of the cord remaining undiagnosed until the



Fig. 104. Prolapse of the umbilical cord.

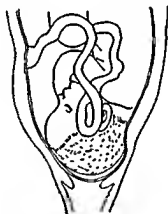


Fig. 105. Occult prolapse of the umbilical cord.

rupture of the membranes. In primigravidae, a floating head after the commencement of labour is indicative of cephalopelvic disproportion and a vaginal examination before the rupture of the membranes is usually done to exclude cord presentation. A second vaginal examination must be carried out immediately after the rupture of the membranes as the cord is likely to prolapse with uncontrolled escape of liquor amni.

In multiparae, the head frequently remains floating until labour is well established and though, from the previous normal deliveries, there may not be any suspicion of cephalopelvic disproportion, a vaginal examination should be done as a routine and, now and again, a cord presentation will be timely diagnosed.

Management of Presentation of Cord. In presentation of the cord, as the foetus is not in any immediate danger of death by asphyxia from compression of the cord, all efforts must be made to preserve the membranes as long as possible. An injection of 100 mg. of pethidine is given to prevent straining and the patient is immediately put in high Trendelenberg position in which position the presenting loop of the cord may recede above the presenting part by the action of gravity. This posture even when it fails to effect recession of the cord, helps by reducing the strain on the lower dependent bag of membranes. The first consideration now is how to effect a rapid delivery of the foetus, and this will depend on as to whether the patient is in the hospital or not.

In hospital practice, the majority of cases of presentation of the cord are treated by caesarean section. The only exception is multiparae in whom the cervix is fully or almost fully dilated. In them, the membranes are ruptured, and the foetus is delivered by the application of forceps in the case of a vertex presentation, or by pulling down the legs and rapid delivery by traction on the breech.

Management of Prolapse of Cord. When the cord has prolapsed, the foetus is in great danger of death as a result of compression of the cord. The management will depend on whether the foetus is alive or is already dead. It is not enough to conclude death of the foetus from the cessation of pulsations in the cord; the foetal heart must be auscultated. When the foetus is dead, labour is allowed to progress naturally, though in an occasional case of contracted pelvis some destructive operation may be necessary. In cases of gross foetal malformation or extreme prematurity, labour is allowed to progress naturally, even when the foetus is still alive. In all other cases, when the foetus is alive, prompt measures are required in the interest of the foetus.

Until recently, reposition of the cord by various ingenious devices was widely advocated; but these tedious and difficult manipulations carried a very high foetal mortality. The management of cases of prolapse of the cord has been critically reviewed in recent years, and reposition of the prolapsed cord is now seldom performed in hospital practice, though it may have some place in cases treated outside large institutions.

Management of Cord Prolapse in a Hospital. The present trend is to perform a caesarean section in the interest of the foetus. All primigravidae, irrespective of the degree of the dilatation of

the cervix, are best treated by caesarean section. Even when the cervix is fully dilated caesarean section is a better choice in primigravidae than delivery by forceps because there is a likely cephalopelvic disproportion in most of the cases and the foetus is jeopardized by a difficult forceps delivery.

In multiparae also caesarean section is the best mode of delivery, the only exception being a multipara in whom cord prolapse occurs after full dilatation of the cervix. A quick forceps delivery is possible in such a case.

During the time preparations are being made for an abdominal operation, the patient is put in high Trendelenberg position and an assistant keeps the presenting part well above the pelvic brim by upward pressure with his two fingers in the vagina. By this way compression of the cord is prevented.

Management of Cord Prolapse outside a Hospital. Since caesarean section cannot be performed, reposition of the cord has to be attempted. The perinatal mortality is very high and, apart from prematurity, the foetal salvage will depend on the ease with which the cord can be repositioned. Reposition of the cord before the cervix is less than half dilated is difficult and unsuccessful in most of the cases. The only method of reposition at this early stage of labour is by hooking the cord in a loop of roller gauze passed through the eye of a gum elastic catheter. The catheter is then passed into the uterine cavity above the presenting part. More often than not, the loop of cord prolapses as the catheter is withdrawn.

When the cervix is more than half dilated, manual reposition is attempted. The loop or loops of cord are gently held in the palm of the hand which is then passed into the uterine cavity above the presenting part. The hand is kept in position and roller gauze is passed alongside the palm. As the gauze is being packed, the hand is gently withdrawn. The cord is prevented from coming down by the support afforded by the packing. The head is pushed into the pelvis by suprapubic pressure and kept pulled by application of a Willett's scalp traction forceps. When the cervix is fully dilated the foetus is delivered by forceps with the gauze still in position.

When the cervix is almost fully dilated and the cord prolapses, the foetus is immediately delivered by forceps. The operation is easy in a multigravida but difficult in a primigravida for the reasons stated above.

CHAPTER 10

ABNORMALITIES OF UTERINE ACTION IN LABOUR

Uterine action during pregnancy and labour has been discussed in Section 4, Chapter . Abnormal uterine action is a very common cause of prolonged labour. The types of abnormal uterine action and their management is described in this chapter.

Classification

The classification of uterine action by Jeffcoate, given below, is the most comprehensive one.

I. Inefficient Uterine Action

Inertia. Hypotonic inertia and normotonic inertia.

Inco-ordinate Uterine Action. (1) Hypertonic lower uterine segment (hypertonic inertia), (2) colicky uterus—asymmetrical uterine action, (3) spurious labour, and (4) constriction ring or contraction ring dystocia.

Cervical Dystocia. (1) Primary rigid cervix; conglutination of the external os; achalasia of cervix). (2) Secondary to disease or previous injury.

II. Over-efficient Uterus. (1) Precipitate labour. (2) Tonic uterine contraction and retraction.

Inefficient Uterine Action

Inertia (Hypotonic Inertia). In this condition there is atony of the uterus manifested by feeble contractions of short duration at long intervals. Caldeyro-Barcia considers the uterus hypotonic when the contractions have an abnormally low intensity (under 30 mm. Hg.) and/or abnormally low frequency (less than 2 contractions per 10 minutes).

The causes of hypoactivity are not yet clearly established but the uterus has the potentiality to contract normally as is shown by the good response to oxytocin infusion. Hypotonic inertia may occur at any or all the three stages of labour.

Clinical Features. The first stage of labour may take several days. The pains occur at long intervals, last for a few seconds, and are so feeble that the patient hardly experiences any pain. Frequently, they stop entirely for several hours but when they reappear they are stronger. The foetus is not in danger even when the membranes rupture early in the first stage, but there is always a risk of intra-uterine sepsis. In some cases, the rupture of the membranes is beneficial as uterine contractions improve soon after with progressive dilatation of the cervix. The cervix remains stationary for one or two days after dilating to 3-4 cm., but once it has dilated to 6 cm. further dilatation usually occurs within a few hours. By the time full dilatation has occurred, the patient is so tired and exhausted that a forceps delivery is needed. In practice, inefficient uterine action is a common indication for forceps delivery. In some, however, after a long, tedious first stage good expulsive effort supervenes, resulting in a spontaneous vaginal delivery.

In hypotonic uterine action, the third stage is likely to be complicated by atonic post-partum haemorrhage and it is advisable to give an injection of ergometrine after the birth of the foetus as a prophylactic measure.

Inco-ordinate Uterine Action. In this condition, there is increased tone in some part of the uterine muscle which persists to a variable extent between contractions. This stage of hypertonicity has been demonstrated by recordings of the intra-uterine tension during and between contractions. The normal resting intra-amniotic pressure is 10 mm. Hg which in a hypertonic uterus reaches as high as 15-20 mm. Hg. The upper or the lower segment may be hypertonic. A hypertonic lower segment is often described as a state of reversed polarity. Persistent backache is a characteristic symptom of this condition.

In inco-ordinate uterine action, instead of the contractions, being in the form of generalised waves they are in the form of abnormal waves localised in some area of the uterus. Caldeyro-Barcia has classified according to the magnitude of the disturbance as "first degree" or "second degree" inco-ordination.

First Degree Inco-ordination. It is caused by the interference in the action of the two normal pacemakers of the uterus. Due to the different rhythm of the two pacemakers, their activity is asynchronous. As a result, small contractions localised to a very small area are totally ineffective, while large ones covering a larger area are capable of dilating the cervix to a certain extent.

Second Degree Inco-ordination or Uterine Fibrillation. In this condition, besides the two normal pacemakers, there are numerous zones controlled by new pacemakers which contract independently and asynchronously. The tonus continuously remains slightly high (13 to 18 mm. Hg). At no time are all the parts relaxed and therefore the amniotic pressure does not fall to the level of the normal tonus (10 mm. Hg). Uterine fibrillation is allied to that described as "*colicky uterus*".

Clinical Features. Labour is very prolonged and painful. The almost incessant suffering makes the patient irritable and anxious, and she tends to loose morale. Continuous backache is a very distressing symptom. The patient feels uncomfortable in the dorsal position and tosses about from side to side. Pain in the hypogastric region is also very annoying to the patient and, frequently, hypogastric discomfort is aggravated by the presence of a distended bladder.

Gaseous distension of the abdomen is a common characteristic of irregular uterine action and the uterus is pushed to one side by the distended colon. Retention of urine adds to the discomfort as the bladder fills up quickly and repeated catheterisation is necessary. A sample of urine must be examined several times a day for acetoneuria.

Abdominal palpation is painful and is resented by the patient. The foetus is not easily palpated because of the hypertonicity of the uterus.

Frequent vaginal examinations are necessary to note the progress of labour. As caesarean section may be the eventual mode of delivery, vaginal examinations should be carried out with full aseptic precautions. The cervix remains thick and is frequently not well applied to the presenting part. When good application of the cervix to the presenting part occurs, it is an indication that normal uterine tone is established and that labour is likely to progress satisfactorily from now on. In some cases, the rectal spasm produces an urge to 'bear down' long before full dilatation of the cervix and this fallacy can only be detected by a vaginal examination. Unless this false urge is realised by the attendant, futile bearing down efforts are likely to exhaust the patient.

Persistent inco-ordinate uterine action with its increased intra-amniotic pressure and increased tone of uterine musculature leads to impairment of the placental circulation. Foetal distress, therefore, frequently complicates labour in these patients.

Inco-ordinate uterine action is frequently replaced by normal action towards the end of the first stage but it may continue during all the three stages of labour. Once the cervix is fully dilated and the head has descended to the level of the ischial spines, inco-ordinate uterine action has less clinical significance as labour can now be terminated by forceps application.

Spurious Labour. Sometimes, the painless uterine contractions, occurring during pregnancy, become painful near term but as the polarity of the uterus is not established the cervix does not dilate. Painful uterine contractions, at short regular intervals, may occur for several days before labour sets in. It is, at times, very difficult to gauge whether such pains are real labour pains. A useful clinical point to remember is that in progressive labour, the contractions increase in tone, duration and frequency, while in spurious labour they remain unaltered.

Constriction Ring or Contraction Ring Dystocia. It is a localised annular spasm of an area of circular muscle fibres of the uterus during labour. It is a rare clinical condition in properly conducted labours. Though its incidence is quoted to be 0.1 to 1 per cent of all labours, our clinical experience at the N.W.M. Hospital has been that spontaneous formation of a constriction ring before delivery rarely occurs when labour is conducted by trained staff. Fortunately, an irreversible ring, that is one which fails to relax even under deep anaesthesia, is extremely rare.

A reversible ring is likely to develop during clumsy intra-uterine manipulations. Injudicious use of forceps sometimes results in constriction ring. Usually, it occurs when forceps are applied before full dilatation of the cervix and the ring develops during fruitless, vigorous pulls to deliver the foetus. Emergency cases of 'failed forceps' are sometimes admitted in which a constriction ring is felt through a partially dilated cervix. Premature and crude attempts at breech extraction can result in a contraction ring. Administration of pitocin to a hypertonic uterus can also lead to a contraction ring. It may rarely arise spontaneously in a 'colicky' uterus.

A ring may form below the presenting part or over the neck, but rarely over the body of the foetus. When it forms below the presenting part, the cervix is thick and hangs loose in the vagina. A constriction ring cannot be palpated by abdominal examination, but on vaginal examination a thick annular ridge is felt. When

the head can be moved from side to side during contraction it is significant. The part of the uterus below the constriction ring remains lax during a contraction. It is stated that constriction ring may occur in the upper segment but with the foetus within the uterus it is impossible to feel it and its presence can only be presumed. The only time a ring in the upper segment can be felt is during internal version.

In the third stage of labour, a ring is commonly observed in the lower part of the uterus and that is usually the result of frequent vigorous Crede's manoeuvre to expel the placenta. An annular spasm imprisoning a separated placenta is sometimes observed following the injection of ergometrine immediately after the end of the second stage.

Cervical Dystocia. Primary. The cause of cervical rigidity and failure to dilate is not properly understood. De Lee mentions that Fieux proved there were practically no muscle fibres in the cervix around the external os near term. However, Nixon studied uterine action in labour by using triple balloon arrangement and showed that the cervix does contract independently of the rest of the uterus.

Clinically, primary rigidity of the cervix occurs in primigravidae and is practically never a cause of dystocia in women who have had a previous vaginal delivery. The cervix is either thick and cartilaginous or thin but non-elastic. The presenting part is frequently well down in the pelvic cavity and is well applied to the cervix.

Prolonged pressure of the presenting part on the cervix sometimes results in ischaemic pressure necrosis, and annular detachment of portion of the cervix above the rigid external os sometimes occurs. Soon after detachment of the cervix the head may present at the vulva with the detached cervix applied to it like a cap.

Conglutination of the external os is a condition in which it is difficult to identify the external os. The whole cervix above the tightly closed os is ballooned out. Sometimes, the tiny os can be located by speculum examination.

Secondary (Organic). In this condition the inability of the external os to dilate is due to excessive fibrous tissue formation resulting from a previous amputation of the cervix, severe trauma to the cervix during previous labour, deep electrocoagulation or conization of the cervix.

Etiological Factors

Age and Parity. It is commonly stated that inefficient uterine action frequently occurs in elderly primigravidae but clinical experience is that age alone does not materially affect uterine action. It may be that in elderly primigravidae the second stage is likely to be prolonged and necessitate a forceps delivery, but this is more due to rigidity of the soft parts than to the inefficient uterine action.

Inefficient uterine action mostly occurs in primigravidae. Inco-ordinate uterine action, on the other hand, though common in primigravidae, also occurs fairly frequently in multigravidae.

Constitutional Factors. *Dystrophia*, *dystocia*, *syndrome*, described by DeLee, occur in stout stodgy women with short neck, who conceive after long periods of infertility. It is characterised by persistent severe hypotonic uterine action which eventually requires caesarean section for delivery.

In India, severe anaemia, due to malnutrition is common among the low income group patients, but, in the absence of cephalopelvic disproportion or malposition of the foetus, labour is surprisingly easy in these women.

Relationship of Occipito-posterior Position to Uterine Dysfunction. It is a common clinical observation that occipito-posterior position of the head and inefficient uterine action are frequent accompaniments. When the head presents with the occiput in an anterior position it fits snugly to the lower uterine segment and it is suggested that the poor uterine action in occipito-posterior positions is due to the head not fitting closely to the lower segment. The descent of the head is slow and, frequently, it remains at or just below the pelvic brim and requires abdominal section for delivery. A clinical observation in favour of uterine inefficiency being due to occipito-posterior position of the head is that, in some cases of android pelvis, occipito-posterior position recurs in successive pregnancies with uterine inefficiency in each of them.

Causes in Uterus Affecting Contractility. In minor degrees of malformations of the uterus, inco-ordinate uterine activity frequently occurs as the downward wave from the pacemakers is not synchronous. In a double or bicornuate uterus, on the other hand, rhythmic contractions from the pacemaker of its own side occur but due to the relative underdevelopment of the myometrium there may be hypotonic uterine action.

Theoretically, multiple intramural fibromyomata should give rise to irregular uterine action but in practice it is not so.

There is a difference of opinion as to whether overdistension of the uterus due to multiple pregnancy or hydramnios can affect uterine motility. Overdistension is a relative term and labour proceeds normally in a moderately overdistended uterus. In excessive overdistension with the girth exceeding 95-100 cm. at term, labour is frequently prolonged due to inefficient uterine action.

Treatment Of Inefficient Uterine Action

Whatever may be the eventual outcome of labour, the immediate treatment of all forms of inefficient action is conservative. An initial routine examination of the patient must be carried out to exclude gross disproportion, malposition of the foetus, or any other mechanical cause which may require abdominal section for delivery. In cases of mild disproportion or occipito-posterior position, conservative treatment is commenced and the patient carefully observed for progress of labour. The essential features of treatment are: (1) general measures, (2) sedatives, (3) oxytocics, and (4) operative measures.

General Measures. In expectation of a prolonged labour, the general care of the patient is important and the occurrence of maternal distress in most of the cases indicates neglect of general measures.

The morale of the patient must be kept high by encouragement and reassurance. The patient should be encouraged to take light meals, fruit juices, and liquids in adequate quantities. A patient who does not take sufficient nourishment by mouth must be given intravenously 200 c.c. of 25% glucose every 6 to 8 hours. Vitamin C, 500 mg., and 10 c.c. of 10 per cent calcium gluconate are added to alternate injections of glucose. Urine should be tested every 6 hours for acetone as acidosis is likely to develop in a prolonged labour.

The bladder is kept empty and it may be necessary to catheterise the bladder every few hours. Gaseous distention frequently occurs in prolonged labour, but an enema gives very little relief.

As labour is usually prolonged and operative interference is frequently necessary, antibiotics should be started as a prophylactic measure.

Sedatives. Continuous abdominal pain and backache in inco-

ordinate uterine action is the most distressing symptom making the patient irritable, nervous and apprehensive. Reassuring the patient is very important. Sedatives should be started early in labour and liberal doses at repeated intervals must be given. Two drugs which have stood the test of time and hold the field are morphia and pethidine. Morphia used to be the drug of choice before pethidine was introduced. Morphia, $\frac{1}{4}$ gr., is injected initially and $\frac{1}{8}$ or $\frac{1}{6}$ gr. repeated every few hours as required. Morphia crosses the placental barrier and therefore is likely to cause foetal asphyxia at birth but, in practice, it does not appear to have much depressant action on foetal respirations if it is given 2-3 hours before birth.

Pethidine is widely used and has to a large extent replaced morphia, both for its sedative and antispasmodic action. Liberal doses should be given and as much as 500 mg. or even more can be given during a prolonged labour with safety to the mother and the foetus.

Chlorpromazine group of drugs are frequently given early in labour and, besides having a tranquillising effect, they help to reduce the subsequent dosage of pethidine.

Barbiturates find favour with some but their action cannot be compared with that of pethidine and morphia.

Chloral hydrate and potassium bromide have practically no place in modern obstetrics.

Oxytocics. Formerly, pitocin or pituitrin was given in 1-2 unit doses at half hourly intervals, but the present technique is to give intravenous drip containing $2\frac{1}{2}$ units of pitocin or syntocinon in 500 ml. of 5% glucose solution. The rate of flow is controlled according to the response of the uterus.

The action of oxytocin infusion is to increase the intensity and frequency of uterine contractions. It is, therefore, most useful in hypotonic uterine inertia and gives good results as it intensifies and increases the frequency of the rather weak rhythmic uterine contractions.

There is difference of opinion regarding the place of oxytocic infusions in inco-ordinate uterine action. According to Caldeyro-Barcia, it normalises the contractions but Jeffcoate states that it merely intensifies the existing pattern of contractions without producing a co-ordinated response. Our opinion is that infusion drip should be given a trial in inco-ordinated uterine action but, if progress of labour does not occur in 2-3 hours as indicated by dilatation of the cervix, or well application of the presenting part to the

cervix, or if foetal distress appears, it should be discontinued and sedative measures pursued with still greater vigour.

Operative Measures. Place of Forceps Delivery. Both, in hypotonic inertia and in inco-ordinate uterine action, the first stage of labour is prolonged and by the time the cervix is fully dilated, the patient is so tired and exhausted that she is unlikely to coöperate in the bearing down efforts. This is particularly true for primigravidae and, provided the conditions for safe forceps delivery are present, she should be relieved of further distress of a prolonged second stage. A spontaneous vaginal delivery in multigravidae frequently occurs but should progress in the second stage be slow, they too must be delivered by forceps.

In inefficient uterine action, the head is frequently in posterior position so that manual rotation and forceps extraction are often necessary. A proper assessment of the station of the head should be done as forceps delivery is frequently difficult, more so if the head is above the ischial spines. It is advisable to undertake such forceps deliveries with full preparations for caesarean section, should the head fail to descend with tentative pull by the forceps.

Dührssen's Incision of Cervix. In primary (functional) rigidity of the cervix, incision of the cervix is indicated only when the cervix has thinned out, is atleast 6 cm. dilated, and well applied to the head. The cervix is incised for a distance of one inch in the 10 o'clock and 2 o'clock positions. As the well applied head slips out there is a danger of the incisions extending further into the lower uterine segment. To prevent this, a stitch is applied to the cervix above the site of incision. Delivery is completed by the immediate application of forceps.

Indications for Caesarean Section. (a) *Hypotonic uterine inertia* of the "dystrophia dystocia syndrome" type usually requires abdominal section. Since the introduction of intravenous oxytocic drip many cases of hypotonic uterine action are delivered vaginally.

(b) Abdominal section is frequently indicated in *hypertonic uterine action*. In elderly primigravidae much time should not be wasted over conservative treatment and an abdominal section is undertaken in the interests of the foetus.

A common impression is that foetal asphyxia occurs only during the second stage of labour but in a hypertonic uterus it may occur also in the first stage. Therefore, no sooner there is evidence

of commencing foetal distress in the first stage, caesarean section should be undertaken.

(c) In some cases of cervical rigidity and constriction ring dystocia.

Treatment of Cervical Rigidity. In functional rigidity of the cervix, conservative treatment is given an extended trial and it is difficult to decide the limit to which conservative treatment should be allowed. In general, if a cervix remains thick, stationary and is not well applied to the presenting part even after the liberal administration of sedatives and a trial of 3-4 hours with intravenous pitocin drip, then a caesarean section is indicated.

Scarring of the cervix following previous obstetric injury generally needs an abdominal section. Besides the inability of the cervix to dilate, there is the danger of extensive laceration during a vaginal delivery.

Treatment of Constriction Ring Dystocia. When the foetus is alive, a lower segment caesarean section is the best mode of delivery. When the ring is below the presenting part, there is no difficulty in delivering the foetus through the lower segment incision but when the ring is gripping some part of the foetus it is necessary to first incise the ring vertically and then deliver the foetus.

In cases of "failed forceps" with the cervix partially dilated and the foetus usually moribund or dead, a wait and watch policy is often successful. Pethidine, 100 mg., is injected and intravenous infusion of 5 per cent dextrose solution is started. Full dilatation occurs within a few hours and by then the ring has disappeared and an easy forceps delivery is effected.

Local infiltration anaesthesia is the most suitable one as spinal anaesthesia is contra-indicated and general anaesthesia carries the risk of aspiration pneumonia.

Inhalation of amyl nitrite or injections of adrenaline hydrochloride have been advocated to relax the ring, but in practice these drugs are usually ineffective during the second stage. However, during the third stage amyl nitrite usually relaxes the ring allowing manual removal of the placenta.

Over-efficient Uterus

Precipitate Labour. In this condition, the process of labour is accelerated by violent contractions and the foetus is delivered

in a disproportionately short time. The cause of forceful and frequent uterine action is not known. Contributory causes are: a small foetus and a large roomy pelvis. Sometimes, unawareness on the part of the patient for several hours to appreciate true labour pains results in unexpected delivery of the foetus but labour in such cases is not really precipitate. Precipitate labour is likely to involve serious danger to the mother and the foetus.

Dangers to Mother. Extensive lacerations of the cervix, the vagina and the perineum with severe traumatic post partum haemorrhage frequently occurs. Atonic post partum haemorrhage is also a serious complication and is caused by the sudden forcible separation of the placenta by traction on the cord during delivery. Delivery may occur in unexpected places and cases are on record of the patient having died due to lack of help.

Dangers to Foetus. Cases of rupture of the cord, and fracture of the skull from fall on the floor, have been recorded.

Treatment. As these cases occur unexpectedly, aid in the form of administering a general anaesthetic to reduce uterine activity is seldom possible. To avoid bad perineal tear an episiotomy should be done. A case of precipitate labour must always be examined for lacerations of the genital canal.

Tonic Uterine Contraction and Retraction. Any mechanical obstruction to labour which prevents the descent of the presenting part eventually causes tonic contraction and retraction of the uterus. At the commencement of labour, the uterine contractions are normal with progressive shortening of the upper segment, stretching of the lower segment and 'taking' up and dilatation of the cervix to some extent. As the foetus is unable to descend with the progress of labour, there is shortening of the upper segment to a greater extent than in normal labour with the corresponding thinning and stretching of the lower segment.

The uterine contractions progressively increase in intensity and frequency. When the frequency of the contractions is more than 5 per 10 minutes, their amplitude is progressively reduced and hypertonus occurs due to incomplete relaxation. The tonus in between contractions is about 30 mm. Hg and at the height of contraction reaches 50-60 mm. of Hg. As a result, the uterus remains so hard between contractions that it appears on abdominal palpation to be in a state of tetanic contraction.

The behaviour of primiparous and multiparous uteri in obstructed labour is different as borne out by clinical experience

and experimental studies. In a case of obstructed labour in a primipara, after a few hours of hyperactivity to overcome the obstruction, the contractions of the uterus become progressively weaker with the development of a typical secondary inertia. But, in a multigravida, the response of the uterus to obstruction is by progressive hyperactivity until a stage is reached when the upper segment is so strongly retracted and the lower segment so stretched and thinned out that spontaneous rupture or rupture during intra-uterine manipulation occurs.

Clinical Features. As a result of persistent hypertonus, there is continuous abdominal pain and backache from overstretching of the lower segment. The uterus is hard and tender. Sometimes, the tense round ligaments are also felt on abdominal palpation (Frommel's Sign). The Bandl's retraction ring demarcating the thick upper segment from the overstretched lower segment is seen as a groove in an abnormally high position.

On vaginal examination, the cervix is thick, partially dilated and is hanging loose in the vagina. The presenting part is felt high up.

Treatment. The immediate treatment is to relax the uterus and thereby prevent rupture. There is no better drug than injection of morphia, $\frac{1}{2}$ gr. Preparation should be made for delivery by a method which involves least interference.

In the present day obstetric practice, caesarean section is the safest and the easiest method, and since the introduction of antibiotics it can be undertaken even in late infected cases.

In outlying areas, craniotomy, decapitation or some other destructive operation is done but the uterus must be manually explored after delivery for presence of rupture.

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CHAPTER 11

CONTRACTED PELVIS

VARIATIONS IN PELVIC ARCHITECTURE

Variations in the architecture of the human pelvis have long been realised by anthropologists. In fact, the pelvis is the most variable of all the bony structures in the body. Many factors, like racial characteristics, evolutionary changes, developmental defects, hormonal or sexual influences, nutritional deficiencies and pathological alterations due to trauma and infection determine the final shape and size of the adult pelvis. Weber, in 1830, provided the first classification of the pelvis into oval, round, four sided and wedge-shaped. His classification was based on morphology alone. Stein's classification, appearing a few years later, was more or less similar and consisted of four types of pelvis, viz. elliptical in transverse diameter, round, elliptical in conjugate diameter and blunt heart shaped. Turner, in 1888, based his classification on the brim index, i.e. $\frac{\text{antero-posterior diameter of the brim}}{\text{widest transverse diameter of the brim}} \times 100$.

He classified pelvis into dolichopellic (conjugate diameter in excess of transverse diameter), platypellic (transverse diameter greatly in excess of conjugate), and mesatipellic (transverse diameter not greatly in excess of conjugate). Turner also observed the resemblance of the dolichopellic pelvis with the pelvis of the anthropoid apes. But, being interested only in the racial variations of the pelvis, he studied only male pelvises to avoid the overlap of sexual characters and hence his classification lacks a type corresponding to the wedge-shaped pelvis of Weber or the blunt heart shaped pelvis of Stein.

To Caldwell and Moloy must go the credit not only for giving us our present concepts about the pelvic architecture in all its aspects but also for revealing to us their significance in relation to childbirth. They studied the pelvises of pregnant women by a special technique of roentgenology developed by them, viz. precision stereoscopy. They too classified the pelvises by the shape of the inlet but emphasized that the characters of the midpelvis and the outlet vary with the shape of the inlet. They divided the

pelvic inlet, at its widest transverse diameter, into an anterior and a posterior segment as an aid in the analysis of the pelvic shape. The anterior segment is formed by the superior rami of the pelvis along the iliopectineal lines and a small portion of the iliac bones and is related to the features of the anterior part of the pelvic outlet. The posterior segment is formed by the sacrum and the portion of the iliac bones lying behind the transverse diameter. This part of the iliac bone forms the summit of the sacrospinous notch and bears a constant relationship to the type of the notch. Caldwell and Moloy classified pelvises into four types (Figs. 106 and 107).

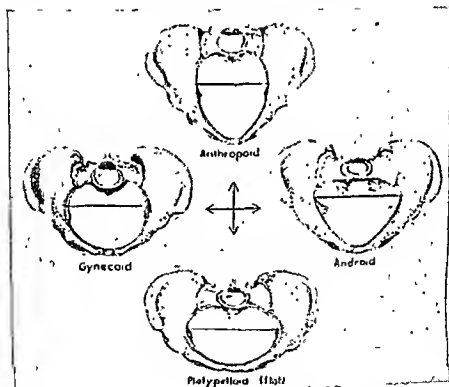


Fig. 106. Four types of pelvises classified by Caldwell and Moloy.

(1) **Gynaecoid Type.** This is the normal female pelvis. The transverse diameter is placed well forward from the sacrum and the inlet is round or slightly ovoid with the transverse diameter a little larger than the anteroposterior one. The side walls are

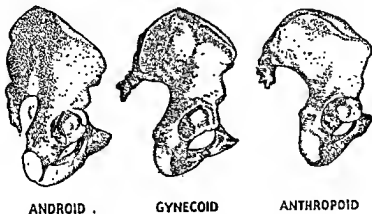
MORPHOLOGICAL FACTORS IN PELVIC STRUCTURE 3

Fig. 107. Morphological factors in pelvic architecture.

straight ensuring adequate transverse capacity throughout to the outlet. The sacrum shows average inclination and curvature. The sacrosciatic notches are wide giving ample space posteriorly. The subpubic arch is wide, almost a right angle, offering adequate space for the passage of the head. During labour, engagement of the head in one of the oblique diameters with the occiput anterior is encouraged. Labour is normal and without any difficulty.

(II) **Android Type.** This pelvis resembles the human male pelvis. The posterior segment is flattened and the transverse diameter is close to the sacrum. The anterior segment is triangular. The inlet thus has a wedge-shaped appearance. The side walls show convergence. The sacrum is shallower and tends to incline forward towards the ischial spines making the sacrosciatic notches narrow. The subpubic angle is narrow. This type of pelvis favours occipito-posterior positions and is often associated with failure of the head to rotate forwards.

(III) **Anthropoid Type.** This shows a resemblance to the pelvis of the anthropoid apes. The transverse diameter is relatively or absolutely narrow and is far away from the sacrum. The conjugate diameter is long being equal to or even greater than the transverse diameter. The sacrum is long and narrow, and, sometimes, has six segments. The promontory is high making the inclination of the plane of the inlet steeper than usual. The sacrosciatic notches are wide and shallow. The side walls are straight. The subpubic arch is of moderate size. In this pelvis, the long posterior pelvis compensates for the narrowed transverse diameter and the

narrowed anterior portion. The conjugate diameter being long, engagement of the head in that diameter is favoured and direct occipito-anterior or occipito-posterior position is common. Lower down in the pelvis, rotation of the occiput anterior from occipito-posterior positions is often difficult and delivery in persistent occipito-posterior or face-to-pubis position is easier.

(IV) **Platypelloid Type.** This is the direct opposite of the anthropoid pelvis and may be considered as a superhuman pelvis. Caldwell and Moloy postulate an evolutionary change in the shape of the pelvis from the long oval (anthropoid) through the round one (gynaecoid) to the transverse flat type (platypelloid). In this type of pelvis, the inlet is transversely oval, the transverse diameter being wide. The side walls are straight. The sacrosciatic notches are wide. The subpubic angle is very wide. The head engages in the transverse diameter at the inlet. Rotation of the head takes place very low down in the pelvis.

Caldwell and Moloy found the distribution of these pelvic types among white women to be as follows—

Gynaecoid type	..	..	41.4 per cent
Android type	..	..	32.5 per cent
Anthropoid type	..	..	23.5 per cent
Platypelloid type	..	..	2.6 per cent

Caldwell, Moloy and D'Esopo consider that during evolution the pelvis changed from anthropoid form, through gynaecoid form, to the platypelloid form. They feel that platypelloid pelvis is the perfect human form of the pelvis. In addition to this evolutionary influence the shape of the pelvis is affected by a hormonal influence which produces male characteristics in the female pelvis. They found that it is uncommon to find pelves presenting all the features of one of the above four pure or parent types. Majority of the pelves show mixed forms. Thus, a pelvis may have anthropoid features in the posterior segment but show gynaecoid characters in the anterior segment. These mixed types are described by a compound classification, e.g. anthropoid-gynaecoid pelvis, the first term referring to the posterior segment and the second to the anterior segment.

Kenny has correlated the body build with the pelvic form. She found that 67.7 per cent of the women with gynaecoid pelvis had typically feminine appearance, while 73 per cent of women with

android pelvis showed masculine features, like heavy build and thick set figure. 81.6 per cent of the women with anthropoid pelvis were tall with wide shoulders and long slender limbs, whereas women with platypelloid pelvis were short in height.

Greulich and Thoms found that among nurses, 80 per cent had round or anthropoid pelvic brim while among clinic patients only 60 per cent had round brim. The former belonged to upper economic group, and were taller and in superior health than the latter. Bernard found that tall women had larger pelves than short women. Ince and Young found a correlation between the height of the women and the true conjugate of the brim. The nutritional status and the build of the patient influence the shape and size of the pelvis. It is, however, very likely that both short stature and flattened pelvis are due to poor nutrition.

CHAPTER 12

CONTRACTED PELVIS

ABNORMAL PELVIS

When a pelvis is so altered in shape or so diminished in size as to disturb the normal process of labour adversely, it is said to be contracted. Generally speaking, when an important pelvic diameter is shortened by 1.5 cm. or more, the pelvis is called contracted. Since in a contracted pelvis it is usually the inlet that offers the first obstacle to the passage of the foetus, it was customary to assess the degree of pelvic contraction by the length of the true conjugate.

Classification

There are various classifications of contracted pelvis based mainly on etiology, or pelvic shape, or both. There is no universally accepted classification but the following one can be considered satisfactory:

- (A) *Resulting from evolutionary, racial and sexual influences:*
 - (a) Small gynaecoid or generally contracted or just minor pelvis.
 - (b) Small android pelvis.
 - (c) Small anthropoid pelvis.
 - (d) Small platypelloid pelvis.
- (B) *Resulting from developmental abnormalities:*
 - (a) Naegle's pelvis.
 - (b) Robert's pelvis (double Naegle pelvis).
 - (c) Assimilation pelvis.
 - (d) Split pelvis.
- (C) *Resulting from nutritional deficiencies:*
 - (a) Rachitic pelvis (rachitic flat pelvis and generally contracted rachitic pelvis).
 - (b) Osteomalacic or triradiate pelvis.

- (D) *Resulting from tumours or fractures of the pelvic bones.*
- (E) *Resulting from disease or deformity of the spine:*
 - (a) Kyphotic pelvis (funnel pelvis).
 - (h) Scoliotic pelvis.
 - (c) Spondylolisthetic pelvis.
- (F) *Resulting from disease or deformity of the lower limbs, like tuberculosis of the hip joint (coxalgic pelvis), poliomyelitis, congenital dislocation of the hip joints, etc.*

Important Varieties of Contracted Pelvis

Generally Contracted, Justominor or Small Gynaecoid Pelvis. This is a miniature normal pelvis differing from it only in size. It is seen in short statured women of delicate features and is in proportion to the rest of the skeleton. All the diameters are smaller than normal and the shape of the pelvis is preserved in general, although there may be minor alterations in the pelvic inclination or sacral curvature.

The etiology of generally contracted pelvis is not definite but heredity, prematurity and improper diet during the years of skeletal growth are believed to be contributory factors.

There is a tendency to use the term generally contracted pelvis in a wider sense to represent a group of pelvis which includes not only the infantile and the dwarf pelvises but also small pelvises with android or anthropoid features.

Rachitic Pelvis (Rachitic Flat Pelvis and Generally Contracted Rachitic Pelvis). Due to rickets, the bones of the pelvis, like the rest of the skeleton, are softened. The softened pelvic bones are subjected to various mechanical forces, like the weight of the trunk and the traction exerted by the muscles and the ligaments. This results in the distortion of the pelvis. The weight of the trunk pressing down on the promontory results in the rotation of the sacrum round a transverse axis passing through the centre of the sacro-iliac joints. The softened sacrum also bends forward. This sinking of the sacrum forwards and downwards leads to the flattening of the brim. The encroaching promontory may even result in a kidney shaped or reniform pelvic inlet. In very severe cases, the softened symphysis pubis yields to the pull of the recti muscles giving the inlet a figure-of-eight appearance. The conjugate dia-

meter is markedly diminished and may measure less than 5 cm. The transverse diameter of the inlet may appear relatively large in contrast to the shortened conjugate, but is usually smaller than normal except in mild cases of rickets. Occasionally, the first sacral vertebra is displaced further forwards than the rest of sacral vertebrae, its projecting lower border giving a false or double promontory (Fig. 107).

The forward pull exerted by the muscles of the pelvic floor and the sacrosciatic ligaments on the lower end of the sacrum and coccyx usually produces a sharp bending forwards of the lower part of the sacrum at the fourth or the fifth segment. The concavity of the anterior surface of the sacrum is affected in both direction so that it becomes flat. In severe cases, the sacrum may even become convex from side to side.

Due to the forward and downward sinking of the upper part of the sacrum, the posterior iliac spines are pulled inwards by the sacro-iliac ligaments and the ilia flare outwards. As a result, the distance between the two anterior superior iliac spines often equals or even exceeds the intercrystal diameter.

The ischial tuberosities are pressed outward by the body weight of the sitting child. This makes the transverse diameter of the outlet wider and enlarges the subpubic angle. The posteriorly tilted lower sacrum and the splayed out ischial tuberosities usually provide a roomy pelvic outlet except when the sacral tip is sharply angulated forward. The acetabula are directed more anteriorly than is normal.

Thus, rickets gives rise to a flat pelvis with peculiar features. This pelvis is best described as rachitic flat pelvis (Figs. 108 & 109).

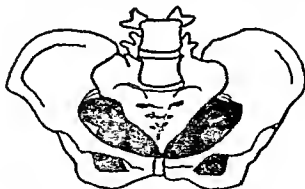


Fig. 108. Rachitic flat pelvis.



Fig. 109. Osteomalacic pelvis.

In severe cases of rickets, the skeletal growth is often stunted and the pelvis is small. Thus, the stunted pelvic growth and the rachitic deformities of the pelvis are superadded to each other giving rise to, what is called, a generally contracted rachitic pelvis or a generally contracted flat pelvis. This type of pelvis is seen in rachitic dwarfs.

The rest of the skeleton often displays stigmas of rickets in the form of square head with frontal bosses, rickety rosary chest, sabre shins and stunted stature.

Osteomalacic or Triradiate Pelvis. Osteomalacia occurring in adult life leads to the softening of the bones. As in rickets, the softened pelvic bones yield under pressure giving rise to pelvic deformity. But the resulting deformity differs from that due to rickets as, unlike an infant, the adult stands and walks. The pressure on the heads of the femurs forces the lateral pelvic walls inward. This pushes the pubic rami forward like a beak and the pelvis is often described as a 'beaked' or 'rostrate' pelvis. The *ischial tuberosities* are approximated, narrowing the pubic arch. The subpubic angle, in severe cases, is so reduced that, during vaginal examination, even one finger cannot be inserted between the pubic rami. The acetabula are turned anteriorly giving rise to the characteristic swinging gait. As in rickets, the sacrum is pushed downwards and forwards. This three-sided encroachment on the pelvic brim, from right, from left and from behind, often reduces the pelvic inlet to a triradiate slit and hence the term 'triradiate' pelvis (Fig. 110).

Kyphotic Pelvis (Funnel Pelvis). Kyphosis in the upper thoracic region is usually compensated for by lordosis in the lumbodorsal or lumbar region, so that transmission of body weight to

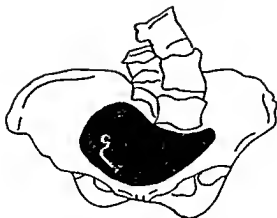


Fig. 110. Scoliotic pelvis.

the sacrum remains unaltered and the pelvis unchanged. But kyphosis in the lumbodorsal region or at a lower level leads to pelvic deformity which is the exact opposite of the one resulting from rickets. The altered line of transmission of the body weight displaces the upper part of the sacrum backward and the lower part of the sacrum is tilted forward. The promontory is displaced backwards and upwards lengthening the conjugate. The sacrum tends to become elongated vertically and narrowed from side to side, while concavity of its anterior surface, both vertical and transverse, tends to be obliterated. The backward displacement of the upper part of the sacrum tends to push apart the postero-superior ends of the iliac bones. This leads to the rotation of the innominate bones around an axis joining the symphysis pubis to the corresponding sacroiliac joint, so that the iliac fossae are flared outward while the ischial tuberosities turn inward towards the midline. The pelvic brim is long and narrow, side walls of the pelvis slope inwards, subpubic angle is narrow, the ischial tuberosities and ischial spines are close together, and the lower part of the sacrum is tilted forwards. Thus the pelvis becomes increasingly narrower as one passes from the inlet towards the outlet, and is aptly described as a funnel pelvis.

Scoliotic Pelvis. Marked scoliosis is usually rachitic in origin. When it involves the upper part of the vertebral column, it is usually compensated by reverse curvature lower down giving an S-shaped curve to the vertebral column and the pelvis remains unaffected. But when scoliosis affects the lumbar region, the sacrum is involved in the compensatory process giving rise to pelvic

asymmetry. Association of rickets and scoliosis results in obliquely contracted flat pelvis, the scoliorachitic pelvis (Fig. 111).



Fig. 111. Scolio rachitic pelvis.

Spondylolisthetic Pelvis. In this rare condition, the last lumbar vertebra slides forwards into the pelvis over the sacrum, carrying the vertebral column with it. This may result from the faulty development of the fifth lumbar vertebra or of the articular processes of the lumbar vertebrae. Subluxation of the joints due to softening of the ligaments during pregnancy may be the cause of the lesser degrees of displacement. The deformity results in the reduction in the available true conjugate, obliteration of the pelvic inclination and the funnelling of the pelvic outlet.

Assimilation Pelvis. In *low assimilation pelvis* there is lumbarisation of the first sacral vertebra. As the sacrum consists of only four vertebrae, the brim is more nearly horizontal and engagement of the head is made easy.

In *high assimilation pelvis*, there is sacralisation of the last lumbar vertebra. As a result, the promontory is high and the inclination of the brim is increased. The brim due to the lengthened conjugate is usually long anteroposteriorly favouring occipito-posterior positions. The depth of the pelvis is increased while there is often a funnelling tendency which may lead to narrowing of the outlet.

Naegle's Pelvis. This oblique or asymmetrical distortion of the pelvis is due to anomaly of development. There is absence or imperfect development of one half of the sacrum. On the affected side there is narrowing of sacral foramina, absence of sacral ala, sacroiliac synostosis, flattening of the lateral pelvic wall and

diminished breadth of the hip bone and its sciatic notch. The sacrum is pushed towards the affected side whereas the pubic symphysis is displaced towards the normal side. All the oblique diameters from the inlet to the outlet are diminished on the sound side though little altered on the affected side. There may be associated congenital malformations, especially of the urinary tract. The patient may show no external evidence of the deformity, like lameness. Clinically, the asymmetry of the pelvis is reflected in the fact that the distances between the posterior superior iliac spine and the opposite anterior superior iliac spine, and between the ischial tuberosity and the opposite greater trochanter are unequal on the two sides as are the measurements between the spine of the fifth lumbar vertebra and the anterior superior iliac spine and between the inferior border of the symphysis pubis and the posterior superior iliac spines (Fig. 112).

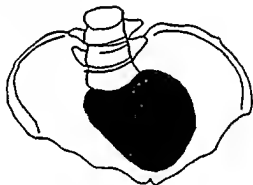


Fig. 112. Naegele's pelvis.

Disease of the sacroiliac joint in infancy also results in an identical oblique contraction of the pelvis. In fact, this pelvic deformity is more often acquired than congenital.

Robert's Pelvis. Bilateral absence of the sacral alae with synostosis of the sacroiliac joints results in a symmetrical transversely contracted pelvis, first described by Robert in 1842 and often designated as double Naegele pelvis. The pelvic deformity can also result from bilateral osteoarthritis of the sacroiliac joints during infancy. Yet, this pelvic deformity is so rare that Little could find only a dozen authentic cases in the literature of the last 120 years. There is a marked diminution of the transverse diameter of the pelvis at all levels (Fig. 113).



Fig. 113. Robert's pelvis.

CHAPTER 13

CONTRACTED PELVIS. DIAGNOSIS

The presence of contracted pelvis is suggested by previous obstetric history, suspected on general and abdominal examination of the patient, discovered by clinical pelvimetry, and confirmed and accurately assessed by radiological study of the pelvis.

Obstetric History. The suspicion that the woman is having a contracted or deformed pelvis is indicated by a history of difficulties during past labours. Obstructed labour, requiring instrumental delivery or prolonged difficult labour resulting in a stillbirth or in the birth of a child with intracranial damage, is suggestive of pelvic contraction.

General Examination. A short stunted stature is often associated with a contracted pelvis, e.g. generally contracted pelvis, rachitic pelvis and osteomalacic pelvis. Marked kyphosis and scoliosis in the thoracolumbar or lumbar region is usually accompanied by a compensatory pelvic deformity. Shortening of a limb and unilateral lameness may suggest an obliquely contracted pelvis. Square head with prominent frontal eminences, rickety rosary chest and bowed tibias and femurs should suggest a rachitic pelvis. Patients with spondylolisthesis have a peculiar gait, best described by the term 'tightrope walker's tread', wherein the footsteps of both the legs fall along the same line. The rare patients with Robert's pelvis have remarkably slender hips. The rhomboid of Michaelis is low and broad, sometimes almost triangular with the base upwards, in rachitic pelvis; is broadened in spondylolisthesis; and is asymmetrical in obliquely contracted pelvis. A pendulous abdomen in a primipara should always arouse a suspicion of marked pelvic contraction. In multiparae, pendulous abdomen is usually accounted for by atonicity of the uterine and abdominal muscles and, hence, does not carry much significance.

Abdominal Examination. Contracted pelvis is the commonest cause of non-engagement of the head in a primipara near term. Hence, it should be obligatory to exclude pelvic contraction in every primipara exhibiting a floating head in the last two weeks

of pregnancy. An abnormal presentation indicates the possibility of pelvic contraction, especially in a primipara.

Clinical Pelvimetry. This consists of two parts, viz. external pelvimetry and internal pelvimetry.

Clinical pelvimetry, especially external pelvimetry, has been gradually losing favour with the obstetricians over the past twenty five years. This is due to the increasing realisation of its lack of accuracy, and the growth and development of X-ray pelvimetry. Some writers feel that external pelvimetry has outlived its utility and it is now time to delete it from obstetrics. Although no one advocates that too much reliance should be placed on external pelvic measurements, many authorities still feel that they are of some value in that they can indicate an abnormal type of pelvis. Internal pelvimetry certainly is more useful than external one.

External Pelvimetry. The diameter of the pelvic inlet cannot be directly measured in the living subject. Certain measurements, including those of the false pelvis, have been traditionally used to obtain the diameters of the pelvic brim by inference, albeit with only moderate accuracy. Size of the outlet can be assessed by external measurements with greater accuracy. All these measurements are made by special metal callipers called pelvimeters (Fig. 114).



Fig. 114. Pelvimeter for external pelvimetry

The best way of handling the pelvimeter during measurements of the inlet is to grasp it in such a way that one blade is grasped from outside while the other one is grasped from inside. This enables the pelvimeter to be supported on the forearm during manipulations. The following are the measurements routinely employed:

(1) *Interspinous Diameter.* This is the distance between the outer borders of the anterior superior iliac spines (Plate 109). It normally measures in Indian women between 21 to 23.5 cm. (8.5 to 9.5 inches).

(2) *Intercristal Diameter.* This is the widest distance between the outer borders of the iliac crests. After measuring the interspinous diameter, the tips of the pelvimeter are made to trace the outer border of the iliac crests guided by the tips of the index fingers. The maximum reading recorded on the pelvimeter gives the intercrystal diameter. Normally, it measures, in Indian women, between 23.5 to 26 cm. (9.5 to 10.5 inches). It is said to measure twice the length of the transverse diameter of the brim but this cannot be relied upon. This diameter normally exceeds the interspinous diameter by at least 2 cm. In flat pelvis, the difference between the two diameters is less than 2 cm. In some rachitic flat pelvis the interspinous diameter may even equal the intercrystal. Interspinous and intercrystal diameters are measured with the patient lying flat with face upwards.

(3) *External Conjugate or Baudelocque's Diameter.* For measuring this diameter the patient should be turned on one side. It is the distance between the tip of the spine of the fifth lumbar vertebra and the midpoint of the upper border of the symphysis pubis. The spine of the last lumbar vertebra can be located by counting the lumbar spines. A simpler way to locate the fifth lumbar spine is to draw a line joining the highest points of the iliac crests. This line usually crosses the spine of the fourth lumbar vertebra and the spine of the last lumbar vertebra lies 1.5 cm. ($\frac{1}{2}$ inch) below this line. An alternative method of locating this spine is to join the two posterior superior iliac spines which are marked on the skin by dimples. The spine of the last lumbar vertebra is situated about 3.5 cm. ($1\frac{1}{2}$ inches) above this line in the midline. In most women, a diamond shaped depression can be seen over the sacral region. This is marked by the posterior superior iliac spines on either side, the spine of the last lumbar vertebra above and the upper end of the natal cleft below. Thus, the posterior borders of the gluteal muscles form the lower sides of this area which is called rhomboid or lozenge of Michaelis (Fig. 115). This rhomboid area becomes low and broad, sometimes almost triangular with the base upwards, in rachitic pelvis; it is broadened in spondylolisthesis and asymmetrical in obliquely contracted pelvis.



Pl-109. Measuring of interspinous diameter. (p. 456)



Pl-110 Measurement of bituberous diameter by the knuckles between ischial tuberosities (p 457).

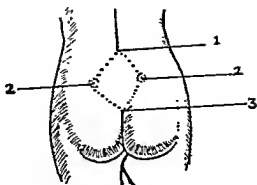


Fig. 115. Michaelis rhomboid.

The external conjugate usually measures, in Indian women, between 17.5 and 19 cm. (7 to 7½ inches). In a normal pelvis, 7.5 to 9.5 cm. (3 to 3½ inches) should be subtracted from it to get the true conjugate but if the pelvis is flat 10 to 10.5 cm. (4 to 4½ inches) must be subtracted to make allowance for the anterior displacement of the promontory.

(4) *Bituberous, Intertuberous or Tuberischii Diameter.* This is the distance between the innermost and lowermost points on the two ischial tuberosities. It normally measures 10 cm. (4 inches). The patient should be placed in lithotomy position for this measurement. Because of the overlying muscles and subcutaneous fat, the end points are difficult to locate and hence in practice assessment of the pubic arch is more valuable than the measurement of this diameter. In fact, the importance of this diameter lies in the fact that its width gives an idea of the subpubic angle. However, the relationship between the subpubic angle and the intertuberous diameter is governed by the depth of the pelvis and, as shown in Fig. 116, the same width of bituberous diameter can be associated with different subpubic angles.

A rough but reliable assessment of the bituberous diameter can be obtained by inserting the knuckles of the hand between the ischial tuberosities. Normally, four knuckles can be comfortably accommodated here (Plate 110).

(5) *Palpation of the Pubic Arch.* The subpubic angle normally measures 85° or more in the female. In clinical practice, the exact measurement of this angle is not necessary. The type of the pubic arch, wide, medium or narrow, and the available subpubic space can easily be appreciated by palpating the rami from the subpubic region to the ischial tuberosities in lithotomy position.

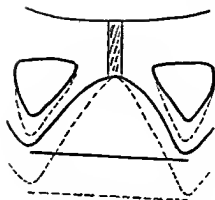


Fig. 116. The same width of bituberous diameter may be associated with different sub-pubic angles.

(6) *Anteroposterior Diameter of Outlet.* This is the distance between the lower border of the symphysis pubis and the tip of the sacrum. This is measured in lithotomy position. It normally measures 13 cm. (5½ inches). This diameter is not considered to be of much clinical utility and there is a tendency to dispense with it since the anterior part of the outlet is best assessed by the bituberous diameter and the subpubic arch, while the posterior part of the outlet is assessed by its posterior sagittal diameter. One point to remember while measuring the anteroposterior and the posterior sagittal diameters of the outlet is that in cases of sacrococcygeal ankylosis both these diameters should be measured from the tip of the coccyx instead of from the tip of the sacrum. Hence, assessing the mobility of the coccyx should be an essential preliminary to the measurement of these diameters. This is best done by grasping the coccyx between the index finger inserted in the rectum or the vagina and the thumb lying externally.

(7) *Posterior Sagittal Diameter of Outlet.* This is the distance between the midpoint of the bituberous diameter and the tip of the sacrum (tip of the coccyx if the coccyx is immobile). This diameter gives an idea of the space available to the emerging bead behind the bituberous diameter. It normally measures 8-9 cm. (3½-3½ inches). However, in view of the fact that the narrowing of the bituberous diameter can be compensated for by a generous posterior sagittal diameter, the sum of these two diameters gives better information than their individual length. According to T¹, when their sum is 15 cm. or more the outlet should be con-

sidered adequate; when it is less outlet dystocia should be anticipated (Thom's Rule).

Internal Pelvimetry. *Diagonal conjugate* and the inter-ischial-spinous diameter are the two important measurements made on internal examination. In olden days, various internal pelvimeters were used for measuring the different diameters of the pelvis directly. They all were clumsy, inconvenient to use and gave unreliable data. They are now obsolete.

(1) *Diagonal Conjugate.* This is the distance between the midpoint of the promontory and the inferior border of the anterior surface of the symphysis pubis. The patient is put in exaggerated lithotomy position, and the index and middle fingers of the hand are introduced in the vagina with due aseptic precautions. The anterior surface of the sacrum is palpated from below upwards. Normally, only the lower three sacral vertebrae can be palpated. Hence, to reach the promontory the hand must be depressed and the perineum pushed upwards by the flexed third and fourth fingers of the examining hand. This enables the examiner to palpate the first two sacral vertebrae and reach the promontory. In rachitic pelvis, the lower border of the first sacral vertebra is sometimes very prominent and can be mistaken for promontory unless due care is taken. This false promontory can be easily detected by pushing the examining fingers further upwards when they will be still in contact with the bone. As against this, beyond the true promontory the bone recedes away from the examining fingers. When the false promontory is mistaken for the promontory the diagonal conjugate will be erroneously found to be longer than it really is. When the promontory cannot be reached at all, the diagonal conjugate can be assumed to be adequate. With the tip of the middle finger in contact with the promontory, the hand is now elevated so that the radial border of the index finger comes in contact with the lower border of the symphysis pubis. This point of contact is marked by the tip of the index finger of the other hand (Fig. 117) and the examining fingers are withdrawn from the vagina. The distance between the marked point and the tip of the middle finger when measured by a pelvimeter or a metal ruler gives the diagonal conjugate.

The measurement of the diagonal conjugate is best done in the last few weeks of pregnancy as the greater distensibility of the vagina and the softened perineum cause less discomfort to the patient. Besides, non-engagement of the head near term indicates the

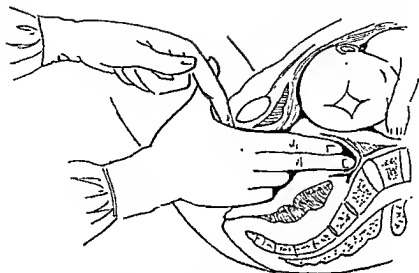


Fig. 117. Measurement of the diagonal conjugate.

necessity of such an examination. When the head is engaged in the pelvis, this examination is neither necessary nor easily possible—not necessary because the engagement of the head means adequate pelvic brim and not easily possible because the engaged head has got to be displaced upwards out of the pelvis.

The diagonal conjugate should normally measure at least 11.5 cm. (4½ inches). Ever since Smellie, in 1752, wrote that the diagonal conjugate measures 1.5 to 2 cm. longer than the true conjugate, it has become an accepted rule. However, the relationship between the diagonal conjugate and the true conjugate is not so simple and is governed by the inclination, height and the thickness of the symphysis pubis as shown by Fig. 118.

(2) *Interischial Spinous or Bispinous Diameter.* This is the distance between the tips of the two ischial spines. This diameter measures 9 cm. and is shorter than the bituberous diameter by 1 cm. No attempts are made to measure this diameter but the two ischial spines are palpated vaginally and a rough assessment of this diameter is made by the clinical impression.

(3) *Palpation of Pelvis.* A thorough palpation of the bony walls of the pelvic cavity should be an essential part of the internal examination. The curvature of the sacrum, both from above and from side to side, should be noted as also the mobility of the coccyx. The length of the sacrospinous ligaments gives

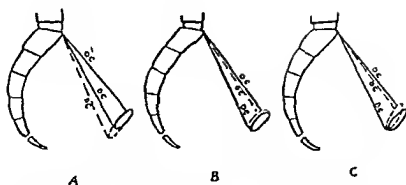


Fig. 118. Relationship between the diagonal conjugate and the true conjugate as governed by the (A) height, (B) thickness and (C) inclination of the symphysis pubis.

an idea of the sacrosciatic notches. Normally, this ligament should be longer than the breadth of the two examining fingers. The side walls of the pelvis should be palpated to note any funnelling tendency.

X-ray Pelvimetry. Whenever a pelvic contraction is discovered or is suspected on clinical study, it can be confirmed and its degree accurately assessed by radiological study. Exact knowledge of the nature of pelvic distortion is invaluable in the management of labour. However, X-ray studies are not devoid of risk and should not be used indiscretely but should be resorted to only when clinical examination is either inconclusive or is inadequate to decide upon the management of the case. For example, when the pelvis is so grossly distorted that vaginal delivery is out of question, the situation could be easily realised on clinical examination without the help of X-rays. The greatest value of X-ray pelvimetry lies in the borderline cases of doubtful or minor pelvic contraction, but its biggest virtue lies in the fact that it gives an exact idea of the relative proportion of the foetal head with reference to the pelvis. The indications, methods and dangers of X-ray pelvimetry are discussed later in the Chapter on Radiology.

CHAPTER 14

CONTRACTED PELVIS. CLINICAL SIGNIFICANCE

Gross pelvic contraction may or may not affect the course of pregnancy but it invariably exerts a sinister influence upon labour. The end results of attempted or accomplished childbirth through a contracted pelvis may be disastrous both to the foetus and the mother.

Influence of Contracted Pelvis Upon Pregnancy

(1) **Incarceration of Uterus.** Pregnancy is unaffected in the early months except in the rare cases of marked pelvic contractions associated with a protruding sacral promontory overhanging the pelvic cavity.

In such circumstances the normal rising up into the abdomen of a retroverted gravid uterus may be prevented with resultant incarceration of the uterus.

(2) **Pendulous Abdomen.** In the late weeks of pregnancy, due to non-engagement of the head, the fundus occupies a higher position and may cause respiratory embarrassment. As the lower segment of the uterus is not fixed by an engaged head and the uterus has greater mobility, it tends to fall forwards pushing the anterior abdominal wall, especially if the capacity of the abdomen is reduced by a kyphotic or a lordotic spine.

(3) **Abnormal Presentation.** Lastly, by preventing engagement of head, a contracted pelvis plays an important role in bringing about abnormal presentations.

Labour in Contracted Pelvis

(1) **Abnormal Presentations.** Abnormal presentations (breech, face, brow and shoulder) occur 3-4 times more frequently in contracted pelvis than in normal pelvis. This may be the result of sliding of the unengaged head laterally into an iliac fossa which produces an obliquity of the foetal axis with reference to that of the pelvic inlet and favours extension of the head. Abnormal presentation often develops secondarily during labour. In a flat pel-

vis, the biparietal diameter may try to bypass the narrow conjugate by moving into one side of the brim. This brings the narrow bitemporal diameter in relation to the conjugate of the brim and the sincipital end of the head descends down in the pelvis. The occipital end may still be held up causing extension of the head and giving rise to abnormal presentation.

(2) **Premature Rupture of Membranes.** The head arrested at the pelvic brim remains high and does not fit the lower segment snugly. The membranes over the cervical os are subjected to the full force of uterine contractions and usually rupture prematurely. Membranes rupture prematurely in nearly 20 per cent of cases with pelvic contraction.

(3) **Prolapse of Umbilical Cord or a Foetal Limb.** Due to imperfect adaptation of the presenting part to the pelvic brim and the lower uterine segment, prolapse of the umbilical cord or a foetal limb is prone to occur after premature rupture of membranes.

(4) **Sluggish Dilatation of Cervix.** Normally, cervical dilatation is the outcome of the hydrostatic wedge action of the intact bag of waters and, after its rupture, the direct action of the head well applied to the cervix. In contracted pelvis the hydrostatic wedge action is cut short by premature rupture of the membranes. After the membranes rupture further cervical dilatation must linger until the head is sufficiently moulded to descend and exert direct pressure on the cervix. In fact, in grossly contracted pelvis the cervix may never dilate fully, the head being unable to descend low enough to press on the cervix.

(5) **Abnormal Uterine Action.** Primary uterine inertia is sometimes seen in a generally contracted pelvis. But, as a rule, nature tries to overcome cephalopelvic disproportion by hyperactive uterine action. Sometimes this is over done, and in the face of mechanical obstruction offered by the pelvis, uterine action is so exaggerated as to result in uterine rupture. Fortunately, when faced with unsurmountable obstruction, the uterus usually accepts defeat and goes into secondary inertia. Occasionally, in prolonged labour, uterine contractions become abnormal and end in tetanic contraction which apart from threatening uterine rupture also endangers placental circulation. Generally speaking, when faced by obstruction a primiparous uterus tends to end in uterine inertia, whereas a multiparous uterus tends to respond by overactivity even to the point of rupture.

(6) **Alterations in Mechanism of Labour.** Normal mechanism of labour is described in Section 4. When the pelvis is of normal size and shape and the foetus is of normal size and presenting by the vertex this mechanism of labour is admirably ideal and, mechanically speaking, most efficient one. When, however, the foetus is faced with a pelvis which is unfavourable in shape and/or size the normal mechanism of labour is altered to adapt itself to the changes in size and shape of the pelvis as described below.

(i) **Flat Pelvis.** The most important feature of a flat pelvis is a diminished true conjugate with or without an increase in the transverse diameter of the brim. The head naturally engages in the transverse diameter of the brim. It negotiates the narrow conjugate by one of the two mechanisms. In the first mechanism the occiput undergoes a lateral displacement so as to enable the biparietal diameter to make use of the relatively wider lateral part of the brim and thus bypass the narrow conjugate. The smaller bitemporal diameter finds less difficulty in passing through the short conjugate. Sometimes the bitemporal diameter passes through the conjugate but even the relatively wider lateral part of the brim is inadequate for the biparietal diameter. This leads to extension of the head and development of a brow or a face presentation.

In the second mechanism the head adopts asynclitic attitudes to negotiate the narrow conjugate. In cases of posterior asynclitism, posterior parietal obliquity or anterior parietal presentation (Naegle's obliquity), the head passes the brim by a movement of gliding of the anterior parietal bone around the pubis. To begin with, there is lateral flexion of the head towards the posterior shoulder. This brings the sagittal suture towards the promontory enabling the anterior parietal bone to enter the cavity. This is followed by lateral flexion of the head towards the anterior shoulder whereby the sagittal suture approaches the pubis, now enabling the posterior parietal bone to enter the cavity. The advantage of this mechanism of asynclitism is that it enables the biparietal diameter to escape direct engagement in the pelvic brim. Instead, first the superparietal-parietal and then the parietal-subparietal diameter engages in the brim and both these diameters are smaller than the biparietal diameter. When there is anterior asynclitism or anterior parietal obliquity (posterior parietal presentation or Litzmann's obliquity), the head passes down the brim by a similar



Pl-111. Assessment of cephalopelvic disproportion by second pelvic grip.
(p. 471).



Pl-112. Assessment of cephalopelvic disproportion by Purandare's method
(p. 472).



Pl-113. Assessment of cephalopelvic disproportion by Muller's method.
(p. 472).

movement of gliding of the posterior-parietal bone around the promontory (Figs. 52, 53).

Once the head passes down the brim, labour, as a rule, is surprisingly easy in a flat pelvis as the outlet is rarely contracted. Sometimes, however, the lower part of the sacrum may encroach forwards causing difficulty at the outlet.

The prominent promontory sometimes has a telling effect on the foetal head resulting in a depression on or a depressed fracture of the parietal bone.

In breech presentation with a flat pelvis, the aftercoming head may present great difficulties during extraction. In fact, the aftercoming head may follow a mechanism identical to that of the forecoming head with anterior parietal presentation whereby, while the posterior parietal bone is arrested at the promontory, the anterior one descends behind the symphysis to be followed by the descent of the posterior parietal bone.

(ii) *Generally Contracted Pelvis.* As the shape of the pelvis remains more or less unchanged, the mechanism of labour is not materially altered. The head meeting equal resistance from all sides of the pelvic brim enters it in the oblique diameter in an excessively flexed attitude. The exaggerated flexion is an attempt to reduce the diameter of engagement to the minimum possible. During vaginal examination, the posterior fontanelle can be readily felt while the anterior fontanelle has usually receded out of reach. Unlike in a flat pelvis, the passage of the head is impeded at all levels of the pelvis. The passage of the head through the outlet is equally difficult as, or may be even more difficult than, its passage through the brim. With an identical shortening of the true conjugate, labour is far easier in a flat pelvis than in a generally contracted one.

Breech presentation in a generally contracted pelvis is often disastrous. Extension of the arms and extension of the aftercoming head are common complications difficult to deal with successfully.

(iii) *Pelvis with a Relatively Narrow Transverse Diameter at the Brim.* Anthropoid pelvis with its long anteroposterior and relatively short transverse diameter encourages engagement of the head in the occipitoposterior position. The high assimilation pelvis with its long conjugate diameter and increased inclination of the brim also favours engagement of the head with the occiput pos-

terior. Android pelvis with its narrow forepelvis forces the head to engage as occipitoposterior.

(iv) *Midcavity Contraction.* Midcavity contraction is almost invariably associated with outlet contraction. The only instance when the capacity of the midcavity is diminished without an outlet contraction is when the sacrum is flat and straight. In such cases internal rotation of the head may not be possible in the pelvic cavity and the head may be required to pass beyond the sacrum before internal rotation can take place low down almost in the pelvic outlet.

(v) *Outlet Contraction.* This is invariably associated with some degree of midcavity contraction. When the pelvis becomes progressively smaller from the brim to the outlet it is called a funnel pelvis. Such funnelling of the pelvis is often seen in kyphotic, spondylolisthetic, high assimilation, android, anthropoid and some generally contracted pelves. The head may have no difficulty in passing down the brim but it meets with increasing resistance as it descends to the level of ischial spines. It undergoes extreme flexion as labour progresses. When transverse and the anteroposterior diameter of the outlet are both contracted the head is usually arrested, natural delivery being impossible. When only the transverse diameter is reduced the head, unable to pass under the narrow subpubic arch tries to utilise the area of the outlet behind the bituberous diameter. The capacity of this space is best indicated by the length of the posterior sagittal diameter of the outlet. Thus with a good posterior sagittal diameter, spontaneous delivery takes place despite a narrowing of the bituberous diameter, albeit resulting in deep perineal tears unless a long episiotomy is made. When the bituberous diameter is inadequate, the posterior sagittal diameter should be expected to compensate for it provided the sum of the bituberous and the posterior sagittal diameters exceeds 15 cm. (Thoms' rule).

Hazards to Foetus in Cases of Contracted Pelvis

The foetus can rarely pass through a contracted pelvis without paying a price. Excessive and sometimes dangerous moulding of the foetal head usually occurs during labour in a contracted pelvis. Moulding that results in a reduction in the biparietal diameter of upto 0.5 cm. is the limit of safety. Further moulding is very likely to result in tentorial tears and intracranial haemorrhages. The prominent promontory sometimes causes apparently visible

trauma to the foetal skull by indenting into the posterior parietal bone and causing a depressed fracture.

Foetal asphyxia is very likely to develop during labour due to: (i) interference with the placental circulation caused by strong and sometimes hypertonic uterine contractions, (ii) intracranial damage, and (iii) cord prolapse. As long as the membranes are intact the foetus is less likely to suffer. But, as explained above, in contracted pelvis membranes rupture prematurely, thereby increasing the foetal risk.

Due to prolonged labour, a large caput often develops over the dependent part of the foetal head. The caput does no harm to the foetus and disappears within a few days after birth but it may lead to serious diagnostic errors as to the level of the foetal head during labour. A large caput might reach the pelvic floor with the head still in the brim and one may undertake an untimely and dangerous forceps delivery if one fails to note the level of the biparietal diameter.

Maternal Hazards in Contracted Pelvis

Labour in a contracted pelvis is always prolonged tending to cause maternal dehydration, exhaustion and genital infection. Sepsis is more likely to occur as a result of premature rupture of the membranes. Labour in contracted pelvis often tends to be obstructed. Persistent uterine efforts to overcome serious obstruction leads to a dangerous thinning of the lower segment ending in its rupture. Uterine rupture is a dangerous complication which if not promptly treated may cost the patient her life.

Undue prolongation of the second stage when the head is jammed in the pelvis devitalises maternal soft parts by compressing them between the head and the pelvis. Necrosis of such devitalised areas leads to the development of vesico-vaginal or recto-vaginal fistulae around the eighth day of the puerperium.

On rare occasions, especially in midcavity and outlet contraction, the symphysis pubis might give way under the strain of labour and rupture spontaneously.

CHAPTER 15

CONTRACTED PELVIS. MANAGEMENT

The principal aim in the management of pelvic contraction is to achieve the delivery with least trauma to the mother and the child. Vaginal delivery, if possible with reasonable safety to the mother and the child, should be preferred to abdominal delivery. But vaginal delivery, per se, is by no means to be aimed at, at all cost. For example, vaginal childbirth resulting in a dead foetus or in a new born with intracranial damage is a poor substitute for an abdominal delivery of a healthy child. It ought to be emphasised, however, that caesarean delivery should not be regarded as an easy way out of an obstetric difficulty. Apart from the fact that abdominal delivery is usually not required for lesser degrees of pelvic contraction, caesarean section is not free from maternal mortality and morbidity. Besides, caesarean delivery is no guarantee for a live baby. Some apparently normal babies, delivered abdominally, die of unknown reasons. Perhaps, the natural processes of labour prepare the foetus for its independent extra-uterine existence.

Many factors have got to be taken into consideration while deciding the actual management of individual cases. Degree of pelvic contraction, size of the foetus or the relative proportion of the foetal head to the pelvis (cephalopelvic proportion) and incidental complications like malpresentations, uterine inertia, cord prolapse, etc. are the important factors. Age and parity of the mother, maturity of the foetus and a precious baby are some of the other factors that often vitiate the line of treatment.

Degrees Of Pelvic Contraction

Assuming the foetus to be of normal size the greatest single factor dictating the management is the exact nature of pelvic contraction. The part of the pelvis that is contracted and the degree of contraction are important considerations. As already indicated, for the same reduction of the true conjugate, a flat pelvis offers a greater chance for spontaneous delivery than a generally contracted pelvis.

The most important single diameter of the pelvis is the true

conjugate. It has been traditional to classify contracted pelves into three groups according to the shortening of this diameter.

(i) **Severely Contracted Pelvis or Major Degree of Pelvic Contraction.** In this group the conjugata vera measures 7.5 cm. (3 inches) or less. The delivery of a live viable foetus through such a pelvis can be considered impossible and an elective caesarean section is mandatory. Some people divide this group further into absolutely and relatively contracted pelves. In the former the true conjugate measures 5.5 cm. or less and vaginal delivery, even of a mutilated child, is impossible. In the latter group (true conjugate between 5.5 and 7.5 cm.) a dead child can be delivered vaginally by a destructive operation.

(ii) **Moderately Contracted Pelvis or a Medium Degree of Pelvic Contraction.** The conjugata vera is more than 7.5 cm. but not more than 9 cm. Spontaneous delivery is possible in over half of the cases depending upon how near the true conjugate approaches the upper limit of 9 cm., the length of the transverse diameter of the brim, size of the foetus, mouldability of the foetal head and nature of uterine action. Since the prospects of successful vaginal delivery in many of the cases in this group are good, they are given a trial of labour unless other factors indicate alternative management. Some cases in this group will need forceps extraction to complete delivery.

(iii) **Slightly Contracted Pelvis or Minor Degree of Pelvic Contraction.** In this group the true conjugate measures more than 9 cm. though less than normal. The reduction in the pelvic capacity is within the limit of reserve capacity of the normal pelvis and hence spontaneous vaginal delivery, perhaps aided by a low forceps application, is to be expected. However, it should be remembered that a large foetus, a malposition or a malpresentation and poor uterine action can vitiate the outcome of labour in this group.

The above measurements of the true conjugate mentioned for the various groups are based on a flat pelvis. When the pelvis is generally contracted all the above measurements have to be enhanced by 0.5 cm.

Radiological classification of the pelvis into Class A, B, C and D (Section 12) is comparable to this clinical classification.

Cephalopelvic Disproportion

The prognosis of labour as judged by the size of the pelvis is true only for an average sized foetus. Thus a small foetus may

pass through a moderately contracted pelvis without the slightest difficulty while a large one may be unable to negotiate a slightly contracted pelvis or even a normal pelvis. Hence, the size of the foetus must be considered in relation to the size of the pelvis before deciding upon the management of a case of contracted pelvis.

The relationship between the size of the foetal head and the size of the pelvis is termed cephalopelvic proportion. Normal pelvis like all organs of the body has a generous reserve and is roomy enough to allow a normal sized foetal head to pass through it with a reserve capacity in the pelvic space. The head lies in the pelvis with free space between it and the bony pelvis. Part of this free space is occupied by the maternal soft parts surrounding the head, viz. the lower uterine segment, loose areolar tissues surrounding it, and the bladder. During labour these tissues are considerably stretched while the bladder becomes an abdominal organ. A good part of the free space around the foetal head, however, represents the reserve capacity of the pelvis which is available during the delivery of a large or a malpresenting foetus. Slight contraction of the pelvis which does not diminish the pelvic space beyond its reserve capacity does not cause any difficulty during the delivery of a normal sized foetus.

When the cephalopelvic proportion is normal the head has no difficulty in engaging into the pelvic brim, which it usually does in the latter weeks of pregnancy in the primipara and in the last few days of pregnancy in the multipara. If, at term, the head is not engaged it can easily be pushed down the pelvic brim.

When the pelvis is contracted or the foetal head is large this normal proportion between the head and the pelvis is upset. The sizes of the head and the pelvis are now disproportionate in relation to each other. In other words, there now exists a cephalopelvic disproportion. Depending on the amount of disproportion between the head and the pelvis, cases of cephalopelvic disproportion are divided into three groups.

(i) **Minor Disproportion.** The head fits snugly into the pelvis and needs the entire pelvic space for its passage down the pelvis. There is no free space at all between the head and the pelvic bones. The head does not engage into the pelvis until labour has been in progress for some time with stretching and thinning of the maternal soft parts and moulding of the head. However, the head is almost sure to pass through the pelvis without difficulty. Spontaneous delivery can be safely anticipated.

(ii) **Moderate Disproportion.** The head is just larger than the pelvis. The anterior parietal bone projects beyond the posterior surface of the symphysis pubis but not beyond its anterior surface. The head might still be able to pass down the pelvis if enough moulding of the head occurs to overcome the disproportion. The outcome of labour is doubtful depending upon the exact amount of disproportion, the ability of the head to mould well and the nature of uterine action. A trial of labour is justifiable. Vaginal delivery aided, if necessary, by forceps extraction will be the outcome in over half the cases.

(iii) **Major Disproportion.** The anterior parietal bone overrides the anterior surface of the symphysis pubis. The head is too large for the pelvis and cannot pass through the pelvis even after it has undergone maximum possible moulding. Vaginal delivery of a live baby is out of question and caesarean section is the treatment of choice.

Detection of Cephalopelvic Disproportion

In the absence of any disproportion the head engages in the pelvis a few weeks before term in primiparae and at term in multiparae. When the head is engaged in the brim cephalopelvic disproportion is obviously ruled out.

When the head is not engaged, the nonengagement may or may not be due to disproportion. Hence, it is necessary to find out whether there is any disproportion and, if it is present, to find out its degree. The inability to push the head down the brim indicates the presence of disproportion whereas the amount of overriding of the symphysis pubis by the head gives its degree.

The examination for disproportion can be carried out by the external or the combined method. In the external method, Plate 111, the patient is best examined in the semisitting position with a back rest inclined at about 45 degrees. This brings the foetal axis in line with the pelvic axis and facilitates the engagement of the head into the brim. The head is now grasped between the two hands, one on either side, and pushed down into the pelvic inlet. If the head can be pushed into the pelvis there is no disproportion. If it cannot be made to enter the pelvis disproportion is diagnosed and its degree is judged by pressing the head firmly down with one hand and assessing by the other hand the amount of overriding of the symphysis pubis by the head.

Purandare's method of studying disproportion can be used as an alternative (Plate 112). The patient is put in exaggerated lithotomy position with the thighs fully flexed over the abdomen so that the axis of the pelvis is brought in line with the foetal axis. The foetal head is now seized by the left hand and pushed down into the brim. If it cannot be so pushed down there is disproportion. The degree of disproportion is estimated by noting with the fingers of the right hand the extent of overriding of the symphysis pubis by the head.

The combined external and internal or the bimanual method is superior to the external method. The necessity of vaginal examination is its drawback. The bimanual method should be employed when the external method is inconclusive. The patient should be placed in lithotomy position. Two fingers of the right hand are introduced in the vagina till they reach the head. The head is now grasped by the left hand and firmly pressed down into the pelvis. The fingers of the right hand note whether or not the head descends into the brim. This is Muller's method of diagnosing disproportion (Plate 113). Munro Kerr has modified this by advocating the use of the right thumb to estimate the amount of overriding of the symphysis pubis by the head.

Whenever the head can be made to engage into the pelvic brim disproportion at the inlet can be ruled out. Irrespective of the actual measurements of the pelvic diameters the pelvic brim can be considered adequate for that head. Freeland Barbour has emphasised this fact by saying that the foetal head is the best pelvimeter for the inlet.

It must not be overlooked that these methods of estimating disproportion deal only with the pelvic inlet. After ruling out disproportion at the inlet, the outlet must be studied carefully before the management of the case is decided upon.

Treatment of Individual Cases

Once the diagnosis of contracted pelvis has been made during pregnancy, the type of pelvic deformity and the amount or degree of pelvic contraction should be studied, if necessary, by the use of radiological examination. Cephalopelvic disproportion should be confirmed and its degree estimated. Cases of mild pelvic contraction and minor cephalopelvic disproportion can be expected to deliver spontaneously and are best left alone. The degree of disproportion should however be reassessed as pregnancy advances to

term. During labour these cases should be carefully supervised, just like cases of trial labour, lest some unexpected development like premature rupture of membranes, cord prolapse, or uterine inertia complicate labour and upset previous calculations.

Cases with severe pelvic contraction and major cephalopelvic disproportion have no chance of delivering a normal baby through natural passages. For these patients there is no alternative to caesarean delivery. These patients are best treated by an elective caesarian section at term after excluding foetal malformations.

Cases with moderate pelvic contraction and moderate cephalopelvic disproportion form the crux of the problem and tax the judgement and skill of the obstetrician in selecting the proper line of treatment. The choice lies between: (i) caesarean section at term, (ii) induction of premature labour, and (iii) a trial labour. A thorough examination is undertaken at 36th week. This is the earliest at which induction of labour should be undertaken. The pelvis is studied in detail and the disproportion between the foetal head and the pelvis properly scrutinised. A tentative decision as regards the choice of treatment may be made subject to confirmation on subsequent examinations. In fact, the final choice between caesarean section and trial of labour is best postponed till term.

(1) **Caesarean Section at Term.** The amount of disproportion is an important factor in deciding upon caesarean section. Abdominal delivery is usually inevitable if the true conjugate is shorter than 8.5 cm. (3.4 inches) unless the foetus is small. But there are many other factors which weigh the choice heavily in favour of abdominal delivery even in roomier pelvis. Presence of midcavity and outlet contraction should as a rule dictate caesarean section. There is no place for trial of labour at the outlet. Breech presentation with moderate degree of pelvic contraction should be considered very unfavourable for the child, because the degree of cephalopelvic disproportion cannot be properly estimated, labour may be complicated by cord prolapse and difficulties in the extraction of the aftercoming head usually prove fatal for the child. Brow and face presentations may be indicative of serious cephalopelvic disproportion. Thus, in the presence of malpresentation, caesarean section has to be undertaken more readily for moderate pelvic contraction. Elderly primipara, postmaturity and a precious baby are other factors favouring the decision to deliver abdominally. Past obstetric mishaps like stillbirth and traumatic forceps delivery, weigh the odds heavily against vaginal delivery.

(2) **Induction of Premature Labour.** Thanks to the safety with which caesarean section can be undertaken, induction of premature labour for pelvic contraction can now be considered almost obsolete. In bygone days, when abdominal delivery was fraught with dangers, this treatment had some justification. In today's obstetrics it has hardly any place. Nevertheless, some British obstetricians still champion this mode of management. In any case, there is almost universal agreement that this treatment has no place in primiparae as in them uterine action and behaviour of the cervix cannot be predicted and the maternal soft parts are rigid.

The purpose of inducing labour prematurely is to get a smaller foetus with its small and more easily mouldable head to pass through the pelvis. What cannot be achieved by the full term foetus can be expected to be easily accomplished by the smaller foetus. However, the prematurity of the foetus, the mainstay of this treatment, is its greatest drawback. The premature foetus is very prone to injury, especially intracranial damage, during labour and is a liability during the neonatal life. The treatment is, therefore, associated with higher stillbirths and neonatal mortality. Miscalculations as regards the maturity of the foetus and the size of the pelvis sometimes make matters worse by bringing forth an unexpectedly premature baby or by presenting an unexpectedly difficult labour. Dewar has put the objections to this mode of management in a nut-shell when he says that the earlier the induction the greater the foetal risk and the later it is done the lesser its justification.

The ideal patient for this treatment, if at all the treatment could be considered, is a second para who in her last delivery had a prolonged labour ending in a stillbirth or a difficult or traumatic forceps extraction. When dealing with such situation one feels that only if the foetus were a little smaller there would have been no difficulty during labour. When the same obstetrician manages the patient in her next pregnancy he can by timely induction of premature labour obtain a little smaller foetus.

Having decided that the case is ideal for induction of premature labour the next important decision concerns the optimum timing of the induction. This is best determined by the size of the foetal head in relation to the pelvis. The patient is studied for cephalopelvic proportion at 36th week, the earliest time when induction of labour should be resorted to. If the head can be made to enter the brim the patient is reassessed at weekly intervals. The ideal

time for induction of labour is when the head just cannot be pushed down the brim. Moulding of the head and thinning and drawing up of the maternal soft parts will enable the head to pass through the pelvis during labour. The decision about the optimum time for induction is no easy matter and needs mature judgment. The usual pitfall is the tendency to induce labour too early in an anxiety to avoid difficult labour.

The prematurely induced labour should be treated like a trial labour and conducted with constant supervision and great care. Most of the cases deliver spontaneously but in a few low forceps delivery might have to be resorted to. In view of the prematurity of the baby difficult forceps deliveries should not be undertaken unless absolutely necessary.

(3) Trial of Labour. Trial of labour is an important development of modern obstetrics which has considerably altered the management of mild or moderate cephalopelvic disproportion. In spite of an exact knowledge of the size, shape and architecture of the contracted pelvis, and even the size of the foetal head, it is not possible to predict the outcome of labour, successful or otherwise. For labour is something much more than the mere ability of the pelvis to allow the passage of the head with or without difficulty. Apart from the relative sizes of the pelvis and the head, there are many other important factors, like the capacity of the head to mould, uterine action and behaviour of the cervix, which can facilitate or delay labour. Unfortunately, these factors cannot be predicted until labour has been in progress for some time. A vaginal delivery which appears very probable, judging from the size of the pelvis and the foetus, may not come through because of poor uterine action. On the other hand, when the chances of the passage of the head through the pelvis appear rather poor, good uterine action and necessary moulding of the head may yet achieve a vaginal delivery. Therefore, in cases of moderate cephalopelvic disproportion, the outcome of labour cannot be predicted, and any treatment based on such predictions cannot be considered sound and rational. The best way to deal with these cases is to allow them to go into labour, and study the progress of labour. If labour progresses favourably, it is allowed to proceed to a successful outcome. If not, all the various above mentioned factors concerned with the process of labour are weighed properly to decide in favour of or against the possibility of vaginal delivery. When vaginal delivery appears unlikely, a caesarean section is promptly undertaken

before the labour has had any harmful effect on the foetus or the mother. This mode of management constitutes a trial of labour. The advent of antibiotics and ready availability of blood for transfusions have made caesarean section safe even when undertaken after a prolonged trial. The advent of trial of labour has not only made inductions of premature labour for pelvic contraction unnecessary and outmoded, but has also salvaged many a woman from an elective caesarean section. More important still, the benefits of a successful trial of labour are perpetuated in subsequent labours which can be confidently managed per vaginam.

Trial of labour is truly a trial of the mother and the foetus, as well as that of obstetrician. The mother has to be sustained, physically and mentally, for a long labour. The foetus has to ensure a long labour with the proper moulding of the head. The patience, judgment and skill of the obstetrician is also on trial.

Indications For Trial Labour

(1) *In primigravidae*, when the head remains above the pelvic brim until the onset of labour with some overlapping, it indicates a moderate cephalopelvic disproportion. An occipitoposterior position is frequently the cause of non-engagement, and is much more unfavourable than the anterior position of the vertex because hypotonic uterine action is commonly associated with occipitoposterior positions.

(2) *Previous Bad Obstetric History.* A previous prolonged labour, with stillbirth or neonatal death within a few days of birth, indicates cephalopelvic disproportion. When the previous confinement had been in a hospital having an experienced obstetric staff, it is easier to judge the success or the failure of trial of subsequent labour than when the previous childbirth was conducted by an inexperienced person. An instrumental delivery after a prolonged labour suggests contraction of the pelvis in the midcavity or the outlet. A thorough clinical examination and X-ray pelvimetry for assessing the size and the shape of the pelvis is of considerable value in judging the outcome of the present childbirth.

(3) *Previous Caesarean Section.* A previous caesarean section performed for cephalopelvic disproportion by an experienced person, after a proper trial of labour, should not be taken as an indication for a repeat caesarean section. The size of the baby and the character of uterine action in the previous childbirth may have

necessitated abdominal delivery, and the same conditions may not be present in the present labour. When the size and shape of the pelvis was the deciding indication in a previous labour with an average sized foetus and good uterine action, a repeat caesarean section would be needed but, even in such cases, trial of labour should be considered. Narvekar reviewed labour following a previous caesarean section and showed that over half of these cases delivered per vaginam. Trial of labour has belied the former dictum 'once a caesarean always a caesarean'.

Limits of Trial of Labour. A fully extended trial of labour should also be a "test of labour". A complete trial is one in which labour is allowed to proceed for at least two hours after the full dilatation of the cervix. The time factor becomes important when the first stage is prolonged for more than 24 hours. Continuation of the trial is justifiable as long as progress is evident and vaginal delivery appears possible.

There are several factors which may not allow the full trial and require it to be terminated by caesarean section.

(1) *The nature of uterine action* is a very important factor. It is a frequent clinical experience that when failure of trial in a previous labour was mainly due to hypotonic uterine inertia, good uterine action in a subsequent labour results in a spontaneous vaginal delivery. Trial of labour in the presence of inco-ordinate hypertonic uterine action is a very difficult problem. Labour is prolonged and, by the time the obstruction has been overcome and a vaginal delivery is possible, the patient is too exhausted, or the foetus is in distress preventing any further extension of trial.

(2) *The time of rupture of the membranes* is also an important consideration. When the membranes remain intact until the cervix is more than half dilated, trial of labour can be allowed to continue, but should they have ruptured before or soon after the onset of labour, it may not be possible to give a full trial as by the time the cervix is fully dilated, most of the liquor has drained away and the risk to the foetus is considerably increased.

(3) *The age of the patient* is important. An elderly primigravida, over the age of thirty five or one who has conceived after many years of infertility, cannot be allowed a prolonged labour because of increased foetal risk.

(4) *Postmaturity* presents a peculiar problem. Labour has to be induced and, in an induced labour, hypotonic uterine action

is common. This, together with decreased mouldability of the head, limits a trial.

Management Of Trial Of Labour

Whenever a trial of labour has been decided upon, it is preferable to admit the case a few days prior to full term, especially in the hospital class of patients who may not fully appreciate this form of treatment and delay admission until several hours after the onset of labour.

As the labour is likely to be prolonged, it is very important to maintain the general condition of the patient at a high level. What is frequently described as maternal distress is usually the result of neglect to attend to the physical well being of the patient. The mental attitude of the patient towards a prolonged labour goes a long way in extending a trial, and mental preparation of the patient during the latter part of pregnancy is of invaluable assistance. Clinical observation shows that a number of second gravidae, who had caesarean section for supposed cephalopelvic disproportion during their first labour, show a determined attitude in their subsequent pregnancy to go through a vaginal delivery, and such mental attitude helps considerably towards a successful result.

Throughout trial, careful attention should be paid to nourishment, especially the fluid intake. Patients who have received good prenatal preparation cooperate well and take plenty of fluids, including fruit juices during labour, but, those who do not, need six hourly intravenous injections of 200 c.c. of 25% glucose solution. As caesarean section may be required at any time, regular meals should be avoided after the first few hours of commencement of trial. Urine should be tested every few hours for acetone which indicates dehydration and starvation and needs intravenous infusion of 500-1000 c.c. of 5% glucose solution.

The patient must have good rest and enough sleep, and it is wise to give tranquiliser orally in the early stages of labour. To ensure good sleep, 100 mg. of pethidine hydrochloride should be given. There can be no hard and fast rule, but pethidine can be repeated every few hours without adding to the danger of foetal anoxia and, at times, as much as a total of 500 mg. of pethidine can be given during labour without any harmful effects. Chlorpromazine group of drugs and pethidine are two very useful sedatives during labour.

The output of urine should be noted. An overdistended bladder adds to the discomfort, and it is necessary to catheterise the bladder as often as is required. At the onset of trial, an enema should be given as is practised in every labour. Sometimes, gaseous distension of the abdomen after several hours of labour occurs, pushing the uterus to one side, and is an indication of labour having been unduly prolonged. Enema at this stage seldom helps, and should be given with great care as it is likely to rupture the protruding bag of waters.

At the commencement of trial, the position of the foetus is carefully palpated and the sites of the anterior shoulder and the foetal heart sounds are marked on the abdomen so that descent of the foetus can be readily judged. The foetal heart rate is counted at regular intervals throughout the labour. The frequency and character of uterine contractions should be constantly watched. Adequate trial can be given when the contractions are rhythmic and of good intensity. In hypertonic inco-ordinate uterine action, the first stage is unduly prolonged, and, frequently, a trial has to be given up in the interests of the mother, or the foetus, or both.

It is often taught that vaginal examination should not be frequently made in patients who are undergoing a trial for fear of infection, more so because a caesarean section is likely to be required later. Clinical experience, however, is otherwise and, there is little risk of infection even when several vaginal examinations are made with proper asepsis. It is true that, in the early first stage, abdominal examination is sufficient to judge the progress of labour, but, later on, information gathered by vaginal examination is valuable and decisive for interrupting or extending the trial. Rectal examination is futile in judging the progress and the prognosis of labour, and is hardly practised in modern obstetrics.

Usually, the size and the shape of the pelvis are assessed during pregnancy but, when this has not been done previously, clinical assessment is done during labour. Similarly, in cases of anticipated trial, X-ray pelvimetry is done during pregnancy but, if not done, X-ray pelvimetry may be required during labour. Every one is on the alert for likely obstruction at the brim, but it must be stressed that the midcavity and the outlet are equally, if not more, important. When obstruction in the pelvic cavity or at the outlet has not been anticipated and is diagnosed later in labour; after exhaustion of the mother and excessive moulding of the foetal head, maternal and foetal risks are considerably increased.

Progress is judged by the descent of the head and the dilatation of the cervix. When the head engages in the first few hours of trial, it is not necessary to do a vaginal examination until the membranes rupture. But, when the head remains at the pelvic brim, a vaginal examination is justifiably done after a few hours of trial, even before the rupture of the membranes, to note the degree of dilatation and effacement of the cervix, the loose or firm application of the presenting part to the cervix, the position of the presenting part, the degree of moulding and to exclude cord presentation.

A vaginal examination must be made soon after the rupture of the membranes to exclude prolapse of the cord and to note the application of the head to the cervix. Soon after the rupture of the membranes, the uterine contractions become stronger and the head, which upto now had remained stationary at the brim, begins to descend into the pelvic cavity. After rupture of the membranes, vaginal examinations are made every one or two hours to note the dilatation of the cervix, moulding, and possible caput formation. The need for sedatives is best judged on the findings of vaginal examinations.

At intervals, the progress of labour should be evaluated and the conditions of the mother and the foetus assessed. After considering all the factors concerned, one may decide to proceed with the trial in the hope of achieving a spontaneous delivery, or one may consider it advisable to terminate labour. In the latter case, a caesarean section will have to be undertaken unless the labour has progressed far enough to make a forceps delivery possible.

Indication for Caesarean Section. The frequency with which caesarean sections are performed, in cases of trial labour, will vary according to the skill and mature judgment of the obstetrician, but there can be very little difference of opinion regarding the following indications.

(1) *Prolapse of Cord.* The only way of securing a live birth when there is prolapse of the cord with the cervix not fully dilated is by immediate caesarean section.

(2) *Nature of Uterine Action.* Hypotonic uterine inertia of the "dystocia dystrophica syndrome" frequently ends up in caesarean section.

Hypertonic inco-ordinate uterine action prolongs the first stage. Continuous abdominal discomfort leads to maternal exhaustion

and, not infrequently, to foetal distress and then caesarean section is required.

(3) *Arrest of Progress of Labour.* Whenever progress of labour is arrested with the head above the level of the ischial spines, a caesarean section is the only course available.

In uncorrected malpresentation arrested at the midcavity, correction is attempted in the operation theatre with a view to deliver by forceps, but whenever such attempts fail, it is best to deliver by a caesarean section.

(4) *Excessive Moulding.* Cases of excessive moulding of the head in the first or the second stage of labour are best delivered by caesarean section as further strain of a vaginal delivery, especially a forceps delivery, is almost certain to cause gross intracranial injury.

(5) Functional rigidity of the cervix will necessarily need caesarean section. Delayed or sluggish dilatation of the cervix is a bad omen.

(6) Development of foetal or maternal distress during the course of a trial labour needs termination by caesarean section.

Cases Seen For First Time During Labour

When the patient with contracted pelvis is seen for the first time during labour she should be treated as if she had been undergoing a trial labour. A careful study of the pelvis is made and the degree of cephalopelvic disproportion assessed. A decision should be taken as to whether vaginal delivery is likely or whether it is impossible.

If vaginal delivery is likely then the patient should be allowed to proceed in labour which should be managed just like a trial labour. A forceps delivery can be undertaken at an opportune time if necessary.

If live vaginal delivery is impossible, a caesarean delivery should be undertaken provided the foetus is alive and in good condition.

The patient might have already been exhausted by a prolonged and obstructed labour when first seen. She might be dehydrated, have rapid pulse, and be even infected as indicated by fever. Even unsuccessful attempts at forceps delivery might already have been made. In the majority of such cases, the foetus will either be dead or dying. Craniotomy is the best treatment for these cases unless

the pelvis is severely contracted. According to Munro Kerr, craniotomy should not be undertaken if the true conjugate is less than 7.5 cm. In any case, if one feels that even after perforation the head is not likely to pass through the pelvis without resort to cephalotripsy, it is safer to undertake caesarean delivery despite a dead foetus.

Symphysiotomy. Mention must be made of symphysiotomy in the management of selected cases of outlet contraction. When, during forceps extraction, one feels that if the pelvis were just a little wider the extraction could be successfully completed, symphysiotomy should be considered. As an elective procedure this operation has no place. If the outlet contraction is discovered during pregnancy or in early labour, caesarean section is the treatment of choice.

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CHAPTER 16

MALFORMATIONS OF FOETUS

Hydrocephalus

Definition. Accumulation of large amounts of cerebro-spinal fluid in the cranium is termed hydrocephalus.

The fluid first collects and enormously distends the ventricles. The stretched brain substance surrounds the distended ventricles giving an appearance resembling the wall of a cyst. In some, the accumulation is restricted to the ventricles, while in others it bursts through an extremely thinned out brain area and then further accumulation occurs in the sub-arachnoid space or between the arachnoid and the dura mater.

The bones of the vault of the skull are widely separated from one another, thus considerably widening the sutures and the fontanelles. The bones of the base of the skull and the face are not affected so that a typical hydrocephalic appearance of an enormously distended head with small face is presented (Plates 114, 115).

Diagnosis. During Pregnancy. Diagnosis is seldom made before the eighth month of pregnancy. In cephalic presentation, a hydrocephalus is suspected during the last few weeks of pregnancy and is confirmed by X-ray examination. In breech presentation, however, diagnosis is usually not made until the after-coming head of the breech is arrested during labour.

A small hydrocephalus is difficult to diagnose correctly and is considered merely as a case of cephalopelvic disproportion. A moderately enlarged hydrocephalic head is usually suspected during abdominal palpation by broadened lower pole of the uterus in which a large head is palpated which is only slightly ballottable. The feel of the head is elastic and not hard. A very large hydrocephalus is difficult to diagnose by abdominal palpation. Inability to palpate the head either at the upper or the lower pole of the uterus leads one to take an X-ray plate. A crackling sensation during palpation of the lower or the upper pole of the uterus is highly suggestive of a hydrocephalic head.

Whenever a hydrocephalus is suspected an X-ray examination should be done. A hydrocephalus presenting by the head can be readily diagnosed by finding thin bones widely separated from each other (Plate 116). Whilst taking an antero-posterior film in a breech presentation, the foetal head, being nearer to the X-ray tube, is magnified out of proportion to the rest of the foetus giving a false impression of hydrocephalus. A lateral film or a postero-anterior film is necessary to overcome this diagnostic pitfall.

During Labour. During labour, a hydrocephalus presenting by the head can usually be diagnosed by a vaginal examination. Early in labour, the diagnosis is not always easy but when the cervix is half or more dilated, the position of the head above the pelvic brim, the abnormally large size of the head, the wide separation of the skull bones and the wide bulging fontanelles leave no doubt about the diagnosis. A large hydrocephalus is likely to be mistaken for a tense unruptured bag of membranes. And the inexperienced is likely to misdiagnose the soft hydrocephalic head for a breech.

As previously mentioned, a hydrocephalic head in a breech presentation very often remains undiagnosed until the arrest of the aftercoming head above the pelvic inlet. As the head is high above the pelvic brim, the fingers on vaginal examination usually reach as far as the firm basic occiput and the distended vault remains out of reach. At this stage, the unusual dimensions of the head can often be made out on abdominal palpation. When there is an associated spina bifida, the diagnosis of the arrest of the hydrocephalic head is at once apparent. Sometimes, the diagnosis of a hydrocephalic after-coming head is made when large quantities of cerebrospinal fluid drain out after perforation of the after-coming head.

Effect upon Labour. With a small hydrocephalus, spontaneous delivery frequently occurs. A large one detected during pregnancy or early in labour is promptly treated and the maternal risk is not more than that in a normal labour. When a large hydrocephalus remains undiagnosed, labour is obstructed and the violent uterine efforts to overcome the obstruction finally result in rupture of the uterus. The risk of uterine rupture from overdistension of the lower segment is much greater in cephalic presentations. In breech presentations the lower segment does not get over-distended as the rest of the body is born naturally and only the after-coming head is obstructed.

Rarely, the hydrocephalus ruptures during labour with spontaneous birth. That is a fortunate accident, but under no circumstances labour should be allowed to prolong in the hope of such an eventuality.

Treatment. When a hydrocephalus is diagnosed during pregnancy, the patient should be kept under observation until labour commences. With the cervix barely two fingers dilated, the hydrocephalus is drained by tapping the head with a trocar and cannula. Anaesthesia is not necessary and enough fluid is tapped to cause the engagement of the head. Should all the fluid be drained, the completely collapsed head being a bad dilator of the cervix delays labour. It is seldom necessary to crush the base of the head unless there is an associated pelvic contraction. When uterine action is inadequate for spontaneous delivery it may be necessary to apply traction to the vault of the skull even after tapping the head.

For the arrest of the after-coming head in a breech presentation, the postero lateral fontanelle or if that cannot be reached the occipital bone is perforated by Simpson's perforator to tap the cerebrospinal fluid.

An alternative method of tapping the cerebrospinal fluid when the after-coming head is too high for perforation is by opening the spinal column between two cervical vertebrae and passing a malleable silver catheter or a stiff gum-elastic bougie into the cranium. When a spina bifida is found, the catheter or the bougie is passed through the spina bifida into the brain.

In cases of hydrocephalus with delayed, obstructed labour, the uterine cavity must be explored after delivery. It is only by following this routine that cases of rupture of the uterus can be detected early.

Prognosis. The foetal prognosis is bad except for a few cases of mild hydrocephalus which deliver spontaneously.

Maternal prognosis is as good as in normal labour, when diagnosis is made during pregnancy or early in labour.

In neglected obstructed cases, the prognosis is grave and the incidence of rupture of the uterus in such cases is high.

Anencephaly

Incidence. The incidence varies between 0.064 and 0.31 per cent per 1,000 live births.

Causation. Various theories have been put forward to explain

its causation. Anencephaly is caused by a *lethal genotype* in many cases. Quigley has reported a case where in two successive pregnancies anencephalies were born. Talbot, after examining the placenta of 20 malformed foetuses, concluded that the defects in development were due to injury to the placenta and were not hereditary in nature. The most important environmental factor likely to cause a developmental defect is diminished oxygen supply to the foetal blood stream.

Pathology. Pituitary and adrenal hypoplasia are the two characteristic features of anencephaly. Simultaneous hypoplasia of the pituitary and the adrenals has not been reported in an infant that is not anencephalic. A hypoplastic anterior lobe is present. The posterior pituitary lobe fails or is absent. The acidophil cells are significantly diminished or are altogether absent.

Diagnosis. The suspicion of an anencephalus is evident about the seventh month of gestation, when uterine enlargement due to hydramnios occurs. Failure to ballot a head is significant. Diagnosis is established by X-ray examination when the absence of skull shadow together with two small ossified knobs of sphenoids is characteristic of an anencephalus. Anencephalic foetus usually presents by the face (Plates 117, 118).

Treatment. Once the diagnosis is made, labour is induced by rupturing the membranes while the foetus is still small to allow an easy delivery.

In many cases, premature labour occurs and the diagnosis of an anencephalus is made during labour.

In those that proceed to full term, the small head comes out from an incompletely dilated cervix. The shoulders often find difficulty in emerging from the incompletely dilated cervix. As a live foetus is not a consideration, there should be no hurry in extracting the shoulders. In a short time the cervix dilates further and the body is delivered.

Meningocele and Encephalocele

In both, there is a cystic tumour on the outside of the cranium, usually in the occipital region. In meningocele, there is herniation of the meninges filled with fluid through a defect in the cranial bones. Encephalocele is a hernia of the brain covered with meninges. There may or may not be free communication between the tumour and the cranial cavity (Plate 119).

These tumours are soft and small and, as a rule, do not obstruct labour. When they are of large size and are found to obstruct labour, the cyst is collapsed by tapping the fluid. Delivery is then left to nature.

Dropsical Effusions of Abdomen and Thorax

In a few rare cases, hydrothorax has caused obstructed labour. Foetal ascites is somewhat more common and, occasionally, the foetal bladder is so distended with urine as to prevent the birth of the body. Hydronephrosis or polycystic kidneys are rare causes of abdominal distension and dystocia.

Diagnosis. The diagnosis is made after the birth of the head or the breech when the delivery of the rest of the body is arrested. A careful exploration reveals the diagnosis.

Treatment. In most of the cases, tapping the affected cavity with a trocar or cannula is sufficient to complete the delivery but in some eviceration may have to be done.

Spina Bifida

It is usually over the lumbo-sacral or dorsal region of the spinal column. It results from a defect in the vertebral arches. It may or may not be accompanied by a meningocele.

As the meningocele is usually small it seldom obstructs labour but if it does it must be punctured and the fluid allowed to drain.

Sacro-coccygeal Tumours

These tumours are of three different types: (1) a cystic tumour communicating with the spinal column, (2) a teratoma due to inclusion of portions of a second foetus, and (3) a simple or malignant tumour as is found in other parts of the body (Plate 120).

These tumours vary in size but are seldom so large as to obstruct labour. A large tumour needs to be removed by piecemeal excision.

Tumours of Neck

They may be cystic or solid. Cystic hygroma may originate in degenerated lymphatic vessels and may be situated in front or on the nape of the neck. Cystic or solid tumours of the thyroid

gland may attain large size. Small ones do not obstruct labour but a large one causing obstruction requires piecemeal removal.

Achondroplasia (Chondrodystrophia)

Achondroplasia consists of retardation of epiphyseal, but not of periosteal bone growth. It is primarily a faulty growth of cartilage and premature cessation of the endochondral ossification results in short, thick extremities, large head, apparently normal-sized trunk, small pelvis (*pelvis nana*) and deformities of the spine (Plate 121).

Little is known about its causation. According to Kaufmann, it is due to defect of bone-forming tissues occurring in the early weeks of foetal life. It is always congenital and heredity plays a part. It is commonly met with in twins.

Obstetric importance of such cases is that it is associated with hydramnios. Difficulty in delivery seldom arises.

Congenital Ichthyosis (Harlequin Foetus)

Congenital ichthyosis is a rare congenital abnormality. The infant is born with a hard skin which splits and desquamates shortly after birth. The eyelids are everted. These cases are usually still-born or die within a few hours of birth (Plate 122).

Lattuada and Parker, in 1951, reviewed the literature in relation to congenital ichthyosis and also recorded cases of the condition.

Congenital ichthyosis is supposed to be due to accumulation of vernix (*Ichthyosis sebacea*) or to the persistence of a foetal membrane which subsequently splits and desquamates.

Double Monsters

Double monsters are of considerably more importance from an obstetric point of view than single monsters as, unless they are very small, they will always give rise to difficulty during delivery. Double monsters have been elaborately classified but, for practical purposes, they are divided into two main classes.

(1) Those in which one end of the body, either the cephalic or the podalic, is double, the rest of the body being single (Fig. 119).

(2) Those in which there are outwardly two separate in-



Pl-114. Hydrocephalus, front view. (p. 483).



Pl-115. Hydrocephalus, side view. (p. 483).



Pl-116. X-ray showing hydrocephalus. (p. 484).



117 Anencephalus. (p. 486).



Pl-118. X-ray showing anencephalus. (p. 486).



Pl-119. Meningocele. (p. 486).



Pl-120. Sacro-coccygeal tumour. (p. 487).



Pl-121. Chondrodystrophia. (p. 488).



PI-122 Congenital ichthiosis. (p. 488).



PI-123. Bicephalus (p. 489).



Pl-124. Thoracophagus. (p. 489).



Pl-125 X-ray of thoracophagus (p 489).

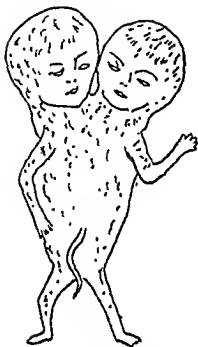


Fig. 119. A teratodeme.



Fig. 120. An ischiopagus monster.

fants, which are joined in only some part of the body. They are further grouped into:

(a) Those in which the infants are connected at the level of the head, *cephalopagus* (Plate 123).

(b) Those in which the infants are connected at the level of the thorax, *thoracopagus* (Plates 124, 125).

(c) Those in which the infants are connected at the level of the pelvis, *ischiopagus* (Fig. 120).

Diagnosis. Double monsters are clinically seldom diagnosed until either spontaneous delivery occurs or when an obstruction to delivery requires intrauterine exploration. By abdominal palpation, a diagnosis of twin pregnancy is made. On radiological examination, a double monster is suspected when both the foetuses are at the same level and particularly when the two are facing each other.

Treatment. If a diagnosis of double monster is made, premature induction of labour should be done so that less difficulty is encountered during the delivery of the small foetuses.

If the diagnosis is made after labour is obstructed, a hand is passed into the uterus to ascertain the nature of the monstrosity.

Breech extraction, after bringing down all the feet, is the best form of treatment. If extraction in this manner fails or is impossible, embryotomy must be performed.

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SECTION VIII

ANTEPARTUM HAEMORRHAGE

Definition. Bleeding from the genital tract at any time after the foetus has become viable, i.e. after 28 weeks, or during the first or the second stages of labour, is designated as antepartum haemorrhage.

Causes. The following are the important causes of antepartum haemorrhage:

- (A) *Haemorrhage from the placenta site*
 - (a) Bleeding due to the premature separation of a placenta situated in the upper segment, *accidental haemorrhage*.
 - (h) Bleeding due to the premature separation of a placenta situated in the lower segment, *placenta praevia*.
 - (c) Bleeding due to the rupture of the *marginal sinus*.
- (B) *Haemorrhage from a velamentous cord or vessels connecting the placenta and its succenturiate lobe crossing the internal os, vasa praevia.*
- (C) *Haemorrhage from lesions in the cervix, vagina and vulva, like vascular polyps, varicose veins, malignant growths, etc.*

CHAPTER 1

PLACENTA PRAEVIA

Definition. Normally, the placenta is situated in the upper segment of the uterus. When the placenta is situated, either partly or wholly, in the lower uterine segment, it is termed *placenta praevia*.

Incidence. The incidence of placenta praevia in a hospital is naturally higher than the general incidence because of the greater number of emergency admissions.

Most reviews on placenta praevia give the incidence of this condition as approximately 1 in 200. The incidence at the N.W.M. Hospital during 1962 was 1 in 162.

In all the reported series, approximately 75-80 per cent of placenta praevia were in multigravidae and 20-25 per cent in primigravidae. This high incidence in multigravidae is perhaps because there are always many more multigravidae than primigravidae. The greater incidence in multigravidae is also due to greater uterine laxity and greater liability to chronic endometrial infection.

Etiology. Why the placenta forms in the lower part of the uterus is not known and is of academic interest only. It is doubtful, if ever, the real cause of placenta praevia will be established.

A fertilized ovum has a smooth external surface until the development of the trophoblast and therefore cannot get attached. Should the formation of the trophoblast be delayed, either as a developmental error or, what is more likely, due to quick transport of the ovum into the uterine cavity before the formation of the trophoblast, the ovum with its smooth surface rolls down into the lower part of the uterine cavity and, finally, only when the trophoblast develops, gets embedded there.

Hofmeier believes that many placenta praevias are the result of the development and the growth of the villi over the chorion laeve which, instead of undergoing atrophy, develop into placental tissue. This placenta bearing part of the decidua capsularis, later, fuses with the decidua vera of the lower segment (capsular placenta praevia).

Strassman thinks that defective vascularisation of the decidua, as a result of inflammatory or atrophic changes, offers inadequate nourishment and forces the placenta to grow and spread further, encroaching upon the lower segment in search of further nourishment.

Lastly, in multiple pregnancies, the large placenta occupies a greater area and is more likely to intrude into the lower segment.

Classification

For clinical purposes, cases of placenta praevia are divided into the following four types:

First Degree (Type 1). The greater part of the placenta lies in the upper segment of the uterus, only the lower edge of the placenta extends into the lower segment (Fig. 121).

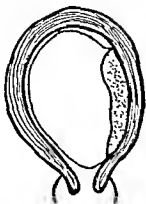


Fig. 121. Diagram showing first degree placenta praevia.



Fig. 122. Diagram showing second degree placenta praevia.

Second Degree (Type 2). The lower edge of the placenta extends as far as the margin of the internal os. The degree is further subdivided into Type 2 anterior and Type 2 posterior according as to whether the placenta is attached mainly to the anterior or the posterior uterine wall (Fig. 122).

Third Degree (Type 3). The placenta completely covers the closed internal os but only partially so when the os is half dilated (Fig. 123).



Fig. 123. Diagram showing third degree placenta praevia.



Fig. 124. Diagram showing fourth degree placenta praevia.

Fourth Degree (Type 4). The lower uterine segment is covered almost completely by placenta even when the os is half dilated (Fig. 124).

The clinical grouping of patients is usually made only in those cases in which the placenta is either palpated in the lower uterine

segment during a vaginal examination or is seen to be implanted in the lower uterine segment at caesarean section. But, with this rigid standard of classification, some of the cases, suggestive of Type 1 placenta praevia, escape detection. When this standard of classification is adopted, a larger number of major degrees of placenta praevia are reported.

The position of the placenta has some significance in the management, as a placenta situated posteriorly is less favourable than the one lying anteriorly. A posteriorly situated placenta encroaches on the room available in the pelvic brim and prevents engagement of the presenting part. As a result, bleeding from separation of a posterior placenta praevia cannot be as readily controlled by rupture of the membranes as in an anterior one. Also, during vaginal delivery, severe foetal anoxia by pressure of the presenting part is greater in a posteriorly situated placenta than in an anterior one.

Morbid Anatomy. The placenta is usually large, thin and irregular. The insertion of the cord is often marginal or vellamentous.

Effects of Placenta Praevia on Pregnancy, Labour, Puerperium and Foetus

Effects on Pregnancy. (a) Repeated bouts of bleeding commonly occur. (b) Premature onset of labour is frequent. (c) As a result of diminution of the space in the lower uterine segment, abnormal presentations are common and the presenting part does not readily engage.

Effects on Labour. (a) Intrapartum haemorrhage is inevitable. (b) With the placenta situated in the lower segment, dilatation of the cervix is likely to be tardy. (c) Operative measures are frequently necessary to arrest bleeding. (d) The vascular, friable lower segment is easily traumatised during manipulations. (e) The cord being near the os, it is likely to prolapse. (f) As the lower segment does not contract and retract as well as the upper segment, post-partum haemorrhage is common. (g) The incidence of adherent placenta is high because the decidua is not as well formed as in the upper segment.

Effects on Puerperium. Puerperal sepsis is likely as a result of operative manipulations, proximity of the placental site to the vagina and lowering of the resistance of the patient by haemorrhage.

Effects on Foetus. (a) Foetus is often malformed as a result of placental deficiency. (b) The foetus is frequently born premature. (c) The foetus is frequently asphyxiated as a result of (i) separation of the placenta, (ii) prolonged pressure of the presenting part on the placenta, (iii) pressure on the prolapsed cord.

Symptoms. Vaginal bleeding is the only symptom of placenta praevia.

The bleeding from a placenta praevia may occur repeatedly before the onset of labour or for the first time during labour. It is usually described as *inevitable, causeless, painless, recurrent* and *profuse*.

It is *inevitable* because during the last weeks of pregnancy, the lower part of the uterus and the cervix stretch to form the lower uterine segment. There is inevitable separation of parts of the placenta during this process of expansion of the lower segment, giving rise to bleeding. Dilatation and 'taking up' of the cervix during labour always results in tearing away of placental tissue attached to it and is accompanied by bleeding.

It is *causeless* because the bleeding occurs in the natural processes of preparation for labour.

The *painless* characteristic of bleeding of placenta praevia is best appreciated by the fact that, in many cases of placenta praevia, bleeding occurs in the middle of the night while the patient is asleep and, on waking up, she at first thinks that she has involuntarily passed urine in bed.

It is *recurrent* because slight separation repeatedly occurs during the formation of the lower uterine segment in the last weeks of pregnancy. First bout of bleeding is usually slight and is a sort of 'warning' bout but subsequent ones are usually more severe.

Diagnosis and Differential Diagnosis

The first bout of bleeding during pregnancy usually occurs any time after the twenty-eighth week. It is usually small. Not infrequently, this 'warning' bout is totally ignored by the patient who makes a casual mention of it at her next antenatal visit and may associate its occurrence to coitus or to some slight exertion. Even those who seek immediate hospitalization are reluctant to remain in the hospital for more than a few days because they feel perfectly well and consider further stay unnecessary. It is usually the second bout that brings realisation to the patient who is then prepared to be hospitalized even for a long period.

Haemorrhage being the only symptom, placenta praevia needs to be differentiated from other causes of antepartum haemorrhage, accidental haemorrhage being the most important of them. Sometimes, excessive 'show' of a normal or premature onset of labour may simulate haemorrhage of placenta praevia. Lesions in the cervix, vagina and vulva are likely to be mistaken for bleeding from placenta praevia but differentiation is readily made on speculum examination. Common local lesions are: a vascular erosion, carcinoma of cervix, a cervical polyp and vaginal vericosity.

Differentiation between placenta praevia and accidental haemorrhage is very important as the management of the two conditions is entirely different.

The bleeding in placenta praevia is sudden and unaccompanied by any other symptoms. It is painless unless labour has already set in. Accidental haemorrhage is often associated with toxæmia of pregnancy. It should be remembered that placenta praevia and toxæmia can be associated in the same patient and therefore mere association of toxæmia should not be regarded as conclusive of accidental haemorrhage.

Abdominal Examination. In placenta praevia the uterus is normal in consistency and is not tender. In accidental haemorrhage, the uterus is tense and tender.

In placenta praevia the presenting part is palpated well above the pelvic brim in major degrees and at the brim in minor degrees. Should the presenting part be deeply engaged, a placenta praevia of any clinical significance can be confidently excluded. On the other hand, the presenting part is frequently engaged in accidental haemorrhage.

A useful physical sign for posterior placenta praevia, as pointed out by Macafee, is the slowing of the foetal heart rate when the head is pressed down into the pelvic brim. It indicates that the umbilical cord is inserted low down in the placenta where it is more likely to be pressed by the head. This sign is important because foetal anoxia during labour is certain to occur and this may be so severe as to cause the death of the foetus.

Vaginal Examination. The propriety of performing a vaginal examination should always be carefully considered. For what little further clinical gain there is the great risk of precipitating profuse bleeding which may well prove fatal to both the mother and the foetus.

A vaginal examination should never be done in the patient's home. Even on admission to a hospital, a vaginal examination should not be undertaken lightly. If, by the time patient is admitted, the bleeding has stopped a vaginal examination is unnecessary. Even if she is bleeding on admission, a vaginal examination should not be done until the operation theatre is ready and the patient is prepared for a likely abdominal delivery. When everything is ready, then a vaginal examination by an experienced person is allowable.

A vaginal examination during labour, by noting the degree of dilatation of the cervix and the type of placenta praevia, helps to decide whether an abdominal or a vaginal delivery is preferable.

Before the onset of labour, a vaginal examination should be done a few days after the first bout of bleeding. If the cervix is patulous, as it often is in a multigravida, it may be possible to pass a finger into the cervical canal. A major degree of placenta will be found covering the os, but no attempt should be made to pass the finger into the lower segment to diagnose a lateral placenta praevia. In doing so, bleeding may be precipitated which will defeat the object of expectant line of treatment.

If the os is tightly closed, the fornices are palpated. If the presenting part can be easily palpated through three of the four fornices a placenta praevia is unlikely.

Management

Immediate Treatment at Home. Frequently, a medical attendant is called upon to see a patient in her home during or soon after a bout of bleeding. The accepted obstetric rule is that every case of antepartum haemorrhage is to be regarded as a case of placenta praevia unless proved otherwise. Apart from recording the pulse rate, blood pressure, and noting the general condition, no further examination is permissible in the home of the patient. A gentle abdominal palpation, to note whether labour has commenced, may be done. An injection of $\frac{1}{4}$ gr. of morphia or 100 mg. of pethidine hydrochloride is given and the patient is transferred to a well-equipped hospital for further treatment.

In rural areas, long distances may prevent immediate transfer of the patient to a hospital and the medical attendant will have to treat the case at home. As a rule, bleeding stops within a short time and the attendant should treat the shock which is directly

proportional to the amount of blood loss. Five per cent glucose infusions, plasma and adrenal cortical hormones are administered according to the severity of the shock. As soon as the general condition of the patient permits, arrangements for transferring the patient to a hospital must be made. A vaginal examination must not be done nor should packing of the vagina be undertaken if the bleeding has stopped. Should the patient continue to bleed, active measures to arrest the bleeding will have to be carried out, howsoever unfavourable the surroundings may be.

For management, cases of placenta praevia are conveniently divided into the following three groups: (1) Expectant line of treatment when bleeding occurs during pregnancy before the 38th week. (2) First bout of bleeding after the 38th week but before the onset of labour. (3) Haemorrhage occurring during labour.

Expectant Line of Treatment

Before 1945, pregnancy was always terminated soon after the first bout of bleeding, irrespective of the term of pregnancy. As a result, foetal loss was very high from prematurity. At that time, blood transfusions were not freely available and termination of pregnancy was logical to save the life of the mother from further haemorrhages. In 1945, Macafee, in Ireland, and Johnson, in the United States, advocated the expectant line of treatment with the object of continuing pregnancy until almost full term and thus allow the foetus to reach maturity. It should be stressed that expectant line of treatment is to be followed only if it does not involve extra risk to the mother.

Expectant line of treatment requires prolonged hospitalization of the patient and that is one of its drawbacks because of the demand on the hospital beds and also because patients are most reluctant to remain in the hospital for several weeks.

Limitations of Expectant Treatment. As expectant treatment is to be carried on in the interests of the foetus only as long as it does not increase risk to the mother, the conditions limiting its application need proper evaluation.

Repeated Bouts of Bleeding. The earlier the bleeding commences in pregnancy, the longer is the period of expectant treatment. As long as the bouts of bleeding are small and occur at the intervals of two to three weeks, expectant treatment can be continued with, perhaps, blood transfusions to replace blood loss. But, when the bouts of bleeding occur at short intervals, and particular-

ly when successive ones are more and more profuse, the advisability of continuing expectant treatment needs constant reviewing. Apart from replacing blood loss by blood transfusions, one of the bouts may be so profuse as to jeopardise the life of the mother and also that of the foetus from anoxia. It is better to terminate pregnancy by caesarean section and risk the problems of prematurity rather than to continue pregnancy and put the life of the mother as well as of the foetus in grave danger.

Anaemia. Nutritional anaemia is widely prevalent in undernourished countries of the East and involves grave risks to pregnant women. Along with anaemia, bouts of bleeding from an associated placenta praevia occur and maternal risk is greatly increased. Whenever haemoglobin is less than 7 gm. per cent, expectant treatment should not be considered.

Premature Onset of Labour. There is always the risk of premature onset of labour in cases of placenta praevia and then expectant treatment is unexpectedly terminated.

Foetal Death. Should intrauterine death of the foetus occur during the period of expectant treatment, there is no advantage in continuing the treatment.

Management of Expectant Treatment. Generally, by the time the patient is admitted, bleeding has become negligible or has entirely stopped. If pethidine or morphia has not already been given, it is injected now. Blood is collected for Rh typing, grouping and cross matching.

The general condition of the patient is examined by taking the pulse and blood pressure. A routine blood count is done. If the general condition is satisfactory no further treatment is necessary, but if the condition is low, or if the blood examination shows anaemia, a blood transfusion is given.

A gentle abdominal examination is carried out. It is possible that she may have started labour which can be observed by the rhythmic contraction of the uterus. In other cases, the uterus is of normal consistency and is not tender in any part of it. A tender and tense uterus indicates accidental haemorrhage as the cause of the bleeding. The presentation and position of the foetus is made out, but no attempt should be made to correct an abnormal presentation. The foetal heart rate is recorded.

A vaginal or a speculum examination must not be done to diagnose the cause of bleeding. The patient is kept at complete rest in bed for at least a week after a bout of bleeding.

After a week, soft tissue radiography, to localise the placental site, is carried out. If the placenta is situated in the upper part of the uterus, a placenta praevia is excluded and further hospitalization is not necessary. A speculum examination is carried out to exclude a vascular erosion, carcinoma of the cervix, a cervical polyp or a varicosity as having been the cause of the bleeding.

Localisation of the placenta in the lower segment by radiography has replaced vaginal examination for diagnosing a placenta praevia. When the cervix is closed, the diagnosis of placenta praevia by vaginal examination is at best inferred by the inability to palpate the presenting part through three of the four vaginal fornices. Radiography, on the other hand, not only locates the placenta as being in the lower segment but also locates its anterior or posterior situation. A speculum examination is purposeless when a placenta praevia is located by radiography.

A blood count is done periodically and anaemia is treated by oral or parenteral treatment. Blood should also be examined on the day following a bout of bleeding. One or more blood transfusions may be necessary during the period of expectant treatment to safeguard the patient against a future bout. In this manner expectant treatment is continued until 38 weeks' term is reached. Maturity of the foetus can be roughly judged by clinical examination but a radiograph may be sometimes necessary to diagnose the size of the foetus.

As a rule, when expectant treatment has been successful until two or three weeks before term, pregnancy is terminated by an elective caesarean section. In a primigravida or a multigravida with previous bad obstetric history, there should be no hesitation in performing an elective caesarean section. There are, however, cases in which continuation of pregnancy to term, in the expectation of a vaginal delivery, can be allowed without added risk to the mother or to the foetus. When, in a multigravida with previous good obstetric history, there has been no further bleeding after the initial bout it is most likely that a minor degree of placenta praevia is present and termination at the 38th week is not absolutely necessary. This wait and watch policy has been repeatedly practised at the N.W.M. Hospital without regret or added risk. Should another bout of bleeding occur between the 38th week and before the onset of labour, caesarean section is immediately decided upon.

First Haemorrhage after 38th Week. When the first bout of bleeding occurs after 38 weeks but before the onset of labour, nothing is to be gained by expectant treatment. As soon as possible, after blood is available, a vaginal examination is done in the operation theatre and necessary active treatment carried out.

Management during Labour. If labour has set in, then it is to be decided whether a vaginal delivery is possible without risk both to the mother and the foetus or a caesarean section is necessary. For this decision a vaginal examination has to be done but, until the operation theatre is ready and properly matched blood is available, it should be withheld.

Until twenty years ago, caesarean section was seldom performed and majority of cases were delivered vaginally by one of the several methods. During the last ten years, larger and larger numbers are delivered by caesarean section, in some series as many as 70-80 per cent. In the N.W.M. Hospital, there were 128 cases of placenta praevia during the two years, 1960-1961, and 45 cases, 35 per cent, were delivered by caesarean section.

In hospital practice, only two of the several methods of delivery per vaginam are nowadays employed. They are rupture of the membranes followed by spontaneous vaginal delivery and rupture of the membranes supplemented by intravenous oxytocic drip. The former is sufficient when uterine action is good, and the latter when uterine contractions are weak. The other methods, version and pulling down a leg, application of Willett's scalp traction forceps, packing of the cervical canal and the vagina, and De Riber's hydrostatic bag, are only occasionally employed because the foetal mortality is very high from prolonged compression of the placenta. The maternal risk is from extra bleeding through manipulations and lacerations of the cervix which may extend high into the lower segment. They have, however, a useful place in outlying rural areas where saving the mother's life is the only consideration in the management of these cases.

Caesarean Section. Indications: (1) When a major degree of placenta praevia is present, caesarean section is the method of choice, irrespective of the parity or progress of labour. (2) In types 1 and 2 posteriorly situated placenta, vaginal delivery is possible but at the cost of considerable risk of foetal anoxia. Therefore, caesarean section is done chiefly in the interests of the foetus. (3) All primigravidae, irrespective of the type of placenta praevia, are best delivered by caesarean section. Labour in a primigravida

takes several hours, even when the cervix is more than half dilated. To avoid the risk of bleeding during this period and to prevent foetal death from prolonged compression of the placenta by vaginal methods, a caesarean section is the method of choice. (4) In multigravida with a previous bad obstetric history, caesarean section is necessary to avoid a complicated vaginal delivery and also the great probability of foetal death.

Type of Caesarean Section. Some time back, classical caesarean section was preferred for placenta praevia to avoid foetal death from loss of its blood by cutting through an anteriorly situated placenta or by accidental cutting of the cord. There is no doubt that this is a rational objection but, since the abdominal incision nowadays is sub-umbilical for both classical and lower segment operation, a final decision can be readily taken after opening the abdomen. There are instances where several large sinuses are seen running across the anterior surface of the lower segment and in such cases it might be prudent to do a low vertical incision.

The chief disadvantage of a classical incision is that, being away from the placental site, it is difficult to check bleeding from the placental bed in the lower segment. Nowadays, there are only a few advocates of classical operation.

When an anterior placenta is seen covering the incision, a quick exploration is done to reach its margin and rupture the membranes there. Otherwise fingers are pushed through the placenta and the foetus is quickly delivered.

Most obstetricians prefer the lower segment operation for placenta praevia. There is no doubt that bleeding during the operation is much more than in a classical operation, particularly when the placenta is situated anteriorly. To reduce the blood loss, all the sinuses running across the line of incision are first tied on two sides by underrunning sutures before making the incision. The chief advantage of lower segment operation is that bleeding from the placental site in the lower segment is under direct vision and can be controlled.

Spontaneous Delivery. In types 1 and 2, spontaneous delivery frequently occurs. The majority of them are multigravidae with good obstetric history and having strong uterine contractions. Out of 128 cases of placenta praevia at the N.W.M. Hospital 47, 37 per cent, delivered spontaneously.

Artificial Rupture of Membranes. This is required when small quantity of blood loss continues to occur during labour. Provided

the uterine action is adequate, the presenting part immediately descends after rupture to compress the placenta and arrest bleeding (Figs. 125, 126). Rupture of the membranes hastens the pro-



Fig. 125. Position of head before rupture of membranes.



Fig. 126. Position of head after rupture of membranes showing compression of the placenta.

gress of labour and, as the majority of them are multigravidae, delivery occurs in a short time.

Version and Pulling down a Leg. Some years ago, version was a popular mode of delivery. During labour, when the cervix was only two fingers dilated, a bipolar version was done and internal version when the cervix was more than half dilated. External podalic version is preferable to bipolar or internal version, followed by pulling down a leg. When the lie of the foetus is transverse, external podalic version is the choice. External version has replaced internal and bipolar versions, chiefly because it is easier to perform as the presenting part is well above the brim and particularly when the foetus is small and premature.

Breech extraction should not be done after pulling down the leg because extraction through an incompletely dilated cervix is liable to cause deep cervical tears with profuse bleeding. Also, during extraction there is a great likelihood of intracranial injury, particularly when the foetus is premature. Breech extraction will thus defeat its own object of delivering a live foetus.

In rural areas where hospital facilities are not available, external version with pulling down a leg must remain a useful method for saving the mother's life. Pressure on the placenta by the half

breech is so great that resulting foetal anoxia leads to a very high foetal mortality of 60 to 70 per cent (Fig. 127).



Fig. 127. Compression of placenta by half breech.

Artificial Rupture of Membranes Followed by Oxytocic Drip. When uterine contractions are weak, the presenting part may not descend after rupture of membranes to effectively compress the placenta and bleeding continues. It is then necessary to increase the force of the uterine contractions by supplementary intravenous infusion of 5 per cent dextrose solution containing $2\frac{1}{2}$ units of oxytocin.

Willett's Scalp Traction Forceps. The scalp traction forceps devised by Willett in 1925 was popular only for a few years. Just as half breech is employed to compress the placental site by pulling down a leg similarly Willett's scalp forceps is utilized for pulling down the head to compress the placenta. Whenever, as a result of weak uterine contractions, the head does not descend to compress the placenta after rupture of the membranes, it is pulled down by traction on the Willett's forceps. Since the introduction of oxytocin drip Willett's forceps is very rarely used. In the series of 128 cases of placenta praevia treated at the N.W.M. Hospital, there was not a single case in which it was necessary to use Willett's forceps.

Its chief advantage is that it can be applied with the cervix less than two fingers dilated. When a reasonably good bold on

the scalp is obtained, traction is exerted by tying one end of a tape to the handles of the forceps and to the other a weight of 1 to 2 pounds.

Vaginal Packing. In well equipped institutions, vaginal packing is never required but, in the rural areas where hospital facilities are not available within a reasonable distance, packing has to be resorted to as a life-saving measure. When the patient is not in labour, it is the only method available under the circumstances to stop the bleeding. For efficient packing of the vagina, anaesthesia is necessary. Frequently, labour starts within a few hours after packing and then the appropriate treatment for vaginal delivery becomes feasible. A pack should not be kept for more than 12 hours because of the risk of sepsis, but antibiotics have considerably reduced the incidence of sepsis.

Third Stage of Labour. Post-partum haemorrhage is a grave complication and a major cause of maternal mortality because even a small haemorrhage in an already exsanguinated patient may prove fatal. Usually, the lower uterine segment contracts and retracts as well as the upper segment, but, when it does not, a grave problem arises. Frequently, the placenta is thin and membranous, and spreads over a larger area than normal. Oozing from such an extensive area in the lower segment will then be difficult to control. As the decidua is poorly developed in the lower segment, the placenta may remain partially adherent and may require manual removal.

Immediately after the birth of the head, $\frac{1}{2}$ c.c. of ergometrine should be injected intravenously and the third stage is conducted carefully. Should bleeding from the partial separation of the placenta occur, manual removal should be immediately done. If the bleeding continues, the lower uterine segment has to be packed to arrest haemorrhage.

Cases have been recorded where hysterectomy had to be done for persistent bleeding, but such a major procedure itself is likely to cause shock and prove fatal in an exsanguinated patient, and therefore it should not be lightly undertaken. Bimanual compression may have to be kept up for a considerable time before the lower uterine segment effectively contracts.

Prognosis. To appreciate the present trends in the treatment of placenta praevia, it is necessary to review the causes of maternal and foetal mortality. Until recently, antepartum haemorrhage was a very important cause of maternal deaths, but the present-

day treatment has done much to reduce the maternal mortality. The main causes of maternal mortality are: collapse from loss of blood, postpartum haemorrhage, puerperal sepsis and rupture of lower segment which along with extra bleeding leads to shock. This reduction has been mainly due to the ready availability of large quantities of blood for transfusion, the introduction of antibiotics, and the hospitalization of all cases of antepartum haemorrhage. The freer use of caesarean section has also been a contributory factor in reducing maternal mortality. The former maternal death rate of 5 to 7 per cent in cases of placenta praevia is now lowered to less than 1 per cent.

Foetal mortality used to be very high because all the efforts were devoted to saving the life of the mother, and the chances of foetal survival were completely ignored. Foetal mortality ranged between 60 and 70 per cent and was never less than 50 per cent. Prematurity took a large toll of foetal lives because it was the rule to terminate pregnancy soon after the first warning haemorrhage for fear of a further large bout of bleeding endangering the life of the mother.

Vaginal delivery in the presence of malpresentations, particularly when the foetus was premature, contributed to increased foetal loss.

The greater liability of a posteriorly situated placenta praevia to cause foetal distress and foetal death during vaginal delivery in a type 2 placenta praevia was also not realised and, as a result, stillbirths frequently occurred. Even today in spite of greater employment of caesarean section, the foetal mortality is as high as 15 to 20 per cent, partly due to prematurity and also due to respiratory distress syndrome.

In India, maternal and foetal mortalities have been reduced in large cities having the above facilities, but in the rural areas placenta praevia is still a major cause of foetal and maternal deaths.

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CHAPTER 2

ACCIDENTAL HAEMORRHAGE

The term *accidental haemorrhage* was introduced by Rigby in 1776 to differentiate it from the haemorrhage due to placenta praevia. Holmes of Chicago in 1901 proposed the term "*ablatio placentae*", the word *ablatio* meaning separation of a part of placenta. De Lee suggested the term "*abruptio placentae*" to mean sudden forcible separation of the placenta from its normal site.

Accidental haemorrhage is usually understood as a cause of antepartum haemorrhage but, in a number of cases, it commences during the first or the second stage of labour. The proper definition of this condition would, therefore, be "premature separation of a normally situated placenta before the onset of the third stage of labour", whatever be the cause of such separation. The risks to the mother are from haemorrhage, shock, renal failure and hypofibrinogenaemia. The risk to the foetus is from anoxia resulting from premature separation of the placenta. The seriousness of this condition, both to the mother and the foetus, demands great alertness and prompt treatment.

Incidence. From 1st January 1959 to 31st August 1960, there were 17,213 confinements at the N.W.M. Hospital. During this period, there were 190 cases of accidental haemorrhage. This gives an incidence of 1:90 confinements. The majority of cases of *abruptio placentae* were emergency admissions. The incidence will vary from place to place depending on the effective antenatal care received by the patients, the incidence of toxæmia of pregnancy and the diagnostic criteria employed. In India, the incidence ranges from 1 in 55 to 1 in 200 confinements.

Age. The greatest number of cases are in the age group 26-30 years, this being the period of maximum fertility. Dyer and McCaughey, and Dass and Vahia report the greatest number of cases in the age group 21-30 years.

Parity. When parity distribution in cases of accidental haemorrhage is compared with the parity distribution of the total number of hospital patients, it can be seen that the incidence of accidental haemorrhage is least amongst primigravidae and it rises as parity increases, markedly so, after parity five.

Table below gives the parity distribution in the series of N. W. M. Hospital.

Parity Distribution Compared to Hospital Patients

Parity	No. of accidental haemorrhage	No. of total hospital admissions (based on 5,000 confinements)
I	11.6%	21.1%
II to V	46.8%	62.9%
VI and above	41.6%	16.0%

Etiology. In roughly a third of the cases, toxaemia of pregnancy is associated. In another 5-10 per cent, a cause apart from toxaemia is responsible for the premature separation of the placenta. In the remaining, the etiology is obscure.

Toxaemic Group. In the N.W.M. Hospital series, the incidence of toxaemia was 31.6 per cent, an incidence much higher than the general incidence. The incidence of toxaemia varies in different series. Hester and Sally had an incidence of 45 per cent, while Waddington reported an incidence as low as 16.5 per cent. Whereas in the severe forms of concealed accidental haemorrhage pre-eclamptic toxaemia is almost always associated, it is absent in many cases of milder revealed forms.

Accidental haemorrhage occurs probably in 5-10 per cent of the cases of hypertension. The malignant variety is more prone to cause the severe form of concealed accidental haemorrhage. When pre-eclamptic toxaemia supervenes in a case of essential hypertension, it is not possible to ascertain which of the two is responsible for the premature separation of the placenta.

Formerly, chronic nephritis was considered to be an etiological factor, but that was before essential hypertension as a clinical entity was recognised.

Non-toxaemic Group. In a small number of cases, accidental abdominal trauma, external version, a short cord and hydramnios are the causative factors. It must, however, be emphasised that in majority of cases, as many as 119 out of 190 in the N.W.M. Hospital series, the etiology was obscure.

Direct Trauma to Abdomen. In the present series, in 5 cases, direct trauma to the abdomen in the form of a kick, a blow or a fall, immediately preceded the onset of accidental haemorrhage. Vigorous manipulations to perform an external version may also

cause the premature separation of placenta but, in this series, such an accident was not recorded.

Short Cord. In 4 cases of this series, a short cord was considered responsible for the premature separation. A short cord is likely to cause premature separation of the placenta by pull on it during the progressive descent of the foetus in the second stage of labour.

Hydramnios. In 2 cases of hydramnios, sudden spontaneous rupture of the membranes was soon followed by the onset of accidental haemorrhage.

Clinical Features and Diagnosis

Clinically, cases of accidental haemorrhage are grouped into: (1) external or revealed, (2) concealed, and (3) mixed. In external accidental haemorrhage, the bleeding is per vaginam with very little or no retroplacental clot formation (Fig. 128). In the concealed variety, there is no external bleeding, all the blood accumulating in the uterine cavity between the decidua and the separated placenta (Fig. 129). As much as 30-40 ounces of clotted

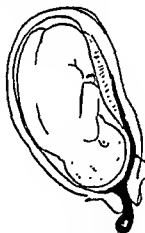


Fig. 128. Diagrammatic representation of revealed haemorrhage.

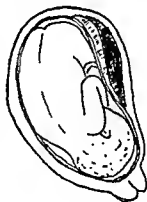


Fig. 129. Diagrammatic representation of concealed haemorrhage.

blood may thus accumulate. In the mixed variety, which is the commonest clinical group, the bleeding is partly external and partly as retroplacental clots.

Page has recently suggested an alternative to the usual classification into revealed, mixed and concealed bleeding. Page classified the cases as follows:

Grade 0. Clinically unrecognised before delivery but diagnosed on examination of the placenta.

Grade I. Cases with external bleeding only or mild uterine tetany but no maternal shock.

Grade II. Cases with uterine tetany, usually with uterine tenderness, foetal distress or death, but no maternal shock.

Grade III. Cases with uterine tetany, intrauterine foetal death, maternal shock and coagulation defects.

External or Revealed. Premature separation may occur at any time after the 28th week. The bleeding is, as a rule, not profuse and is accompanied by abdominal pain. There may or may not be signs of toxæmia. The condition of the patient remains satisfactory with very little rise in pulse rate or fall of blood pressure.

On abdominal examination, the uterus is tense to the feel, and is tender on palpation. In a mild case, tenderness is localised in the upper part of the uterus where the placenta is situated. The foetus is palpated with difficulty through the tense uterus. The presenting part may or may not be engaged. Foetal heart sounds may or may not be present depending on the degree of foetal anoxia caused by the separation. On vaginal examination, a tense bag of membranes is felt whenever the cervix admits one finger.

In majority of cases, labour sets in soon after the bout of bleeding with birth of a premature live foetus or a stillbirth.

Differentiation from placenta prævia is usually not difficult. There may be evidence of pre-eclampsia or, in an occasional case, history of trauma to the abdomen or recently attempted external version. Even in the absence of a suggestive history, the presence of abdominal pain, tenderness on abdominal palpation, and tense consistency of the uterus are sufficient to exclude a placenta prævia. When the presenting part is engaged a major degree of placenta prævia is excluded. The presence of a tense bag on vaginal examination not only excludes a major degree of placenta prævia, but also indicates increased intrauterine tension, a feature of premature separation of the placenta.

Concealed Accidental Haemorrhage. The mild forms of concealed accidental haemorrhage is clinically 'silent', and is sus-

pected when foetal heart sounds stop suddenly prior to or during labour. The diagnosis is confirmed by expulsion of more than eight ounces of old laminated blood clots with the placenta. Frequently, the maternal surface of the placenta shows a depression.

Severe Form of Accidental Haemorrhage. As there is no external bleeding, the diagnosis is based on a well recognised syndrome. It is a very serious condition but comparatively rare. In almost all cases, signs of pre-eclampsia are present.

At the onset, the patient complains of abdominal pain which may be sudden and severe or gradual in onset. The pain is constant and increases in intensity. The most striking feature is the marked pallor and the ill, anxious look of the patient. The shock is out of proportion to the retroplacental collection of blood. The shock is due to stretching of the uterine wall from overdistension of the uterus. The pulse is fast and of low volume. The blood pressure may fall to a very low level but, not infrequently, the blood pressure is normal. This is deceptive because the present normal blood pressure is in reality a marked fall from the previous high blood pressure of the associated pre-eclampsia. The fall, from the previous high level to what is apparently a normal reading now, is a sign of severe shock. The large quantity of albumen in the urine is a reliable sign of associated severe pre-eclampsia.

Abdominal Examination. The uterus is markedly tender on palpation and is very tense to the feel. It is difficult to diagnose the presentation of the foetus as the foetal parts cannot be palpated through the tense uterus. The foetal heart sounds are almost always absent. A vaginal examination does not reveal any additional information. The cervix is usually closed but, when open, a tense bag of membranes is felt.

When a case of severe accidental haemorrhage is left undelivered for a number of hours, grave complications are likely to set in. *Coagulation defect resulting in hypofibrinogenaemia, cortical or tubular necrosis of the kidneys resulting in anuria, and irreversible shock* are fatal complications.

Mixed Type. In this condition, part of the blood escapes vaginally and part of it is retained. Usually, these cases are clinically mild and there may or may not be clinical signs of shock. The mixed nature is usually diagnosed after delivery of the placenta. Expulsion of several ounces of old blood clots and concave indentation on part of the maternal surface of the placenta reveal the true pathology.

Pathology

In *concealed accidental haemorrhage* characteristic changes described by Couvelaire and designated as *uteroplacental apoplexy* are present. By naked eye, the uterus shows ecchymotic patches beneath the peritoneal coat. Sometimes, there are multiple fissures in the peritoneal coat from where the blood is seen oozing into the peritoneal cavity. The external surface has a cyanotic colour, most marked in the area of placental attachment. In the myometrium, the muscle fibres are extensively split up by extravasated blood and oedema. At the placental site, subdecidual haemorrhages are found in some cases. The tubes and ovaries have haemorrhagic areas. Extravasation of blood into the broad ligaments is common (Plates 126, 127, 128).

Histological examination shows streaks of red blood cells between split muscle bundles. Areas of necrosis of the muscle fibres with oedema of the connective tissues are seen throughout the myometrium.

Revealed Accidental Haemorrhage. The only noticeable changes are on the maternal surface of the placenta. A depressed area on the maternal surface by pressure of retroplacental clot is a common finding (Plate 129). White infarcts of varying number and size are seen. The changes in the uterus in concealed accidental haemorrhage are absent in these mild forms.

Hypofibrinogenaemia. It is a complication met with in severe untreated concealed haemorrhage and is due to the release of thromboplastin into the circulation from the separated placental tissue and from the damaged decidua. As a result, intravascular clotting occurs and circulating fibrinogen is so rapidly depleted that the liver is unable to replace it. Small fibrin clots are liberated which may lodge in such important organs, as the lungs, the kidneys and the brain. The liver responds to these thrombotic emboli by liberation of heparin-like substances and fibrinogen. The sequence of these vascular changes can be demonstrated by the clot forming test of Weiner. Failure of blood to clot indicates deficiency of fibrinogen. Normal blood which fails to clot when mixed with blood from a patient having accidental haemorrhage suggests the presence of heparin-like substances in the patient's blood. If the clotted blood from a normal patient liquefies on adding the patient's blood, indicates the presence of fibrinogen.



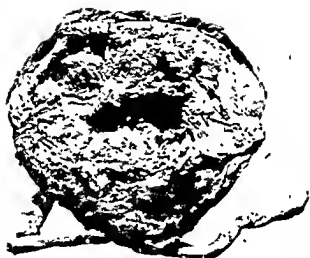
Pl-126. Half section of uterus showing foetus, placenta and retroplacenta clot in situ. (p. 512).



Pl-127 Half section of uterus showing foetus, placenta and retroplacental clot in situ. (p. 512).



Pl-128 External surface of an uterus in concealed accidental haemorrhage.
(p. 512).



Pl-129 Depressed area on the maternal surface formed by pressure of retroplacental clot. (p. 512).

The possible causes of hypofibrinogenaemia are: (1) thromboplastic and fibrinolytic substances, from the damaged placenta and decidua, entering the circulation stimulate the liver to produce heparin-like substances; (2) depletion of circulating fibrinogen as a result of retroplacental clot; (3) failure of the anoxic liver to produce fibrinogen; and (4) blood loss.

The normal plasma fibrinogen level is 200 to 400 mg. per 100 ml. A critical level is 120 mg. per 100 ml., below which uncontrollable bleeding occurs. Complete afibrinogenaemia rarely occurs. The occurrence of typical Couvelaire uterus is explained by extensive extravasation of blood into the myometrium and elsewhere as a result of hypofibrinogenaemia.

Renal Changes. These have been described under "Anuria in Pregnancy". (Section 5, Chapter 11).

Management

The management of accidental haemorrhage is essentially conservative and, unlike placenta praevia, an abdominal delivery is rarely resorted to. In 190 cases of the series at the N.W.M. Hospital, only 4 cases were delivered by caesarean section. In placenta praevia, caesarean section is frequently performed in the interests of the mother and the foetus. Cases of revealed and mixed types of accidental haemorrhage are always delivered vaginally. By present day treatment, cases of concealed accidental haemorrhage deliver vaginally and only in the rare exceptional cases, which fail to respond to conservative treatment, it is necessary to do an abdominal section.

Fortunately, in many cases labour commences simultaneously or soon after the onset of accidental haemorrhage, but, in those cases in which labour does not set in, it is induced by rupturing the tense bag of membranes. This is usually sufficient but it may be necessary to supplement rupture of membranes with an oxytocic drip. In the N.W.M. Hospital series of 190 cases, labour commenced spontaneously in 99 cases, 52 per cent; it was successfully induced in 66 cases, 35 per cent; in 21 cases an oxytocic drip, after rupture of its membranes, was necessary. In the remaining 4 cases, a caesarean section was performed.

Spontaneous Labour. The 99 cases in which labour was spontaneous consisted of two groups: (1) The first and the only bout of external bleeding occurred a few hours prior to or at the commencement of labour. Many of them were multiparae and delivered

within a few hours of admission. (2) There was no external bleeding but foetal heart stopped suddenly prior to or during labour. In all these cases, the diagnosis of accidental haemorrhage was evident by expulsion of 6 to 20 ounces of retroplacental clots. In many of them, a depressed area on the maternal surface of the placenta was present.

✓ **Artificial Rupture of Membranes.** In mild cases of accidental haemorrhage, artificial rupture of membranes is done to hasten labour. Spontaneous delivery occurred in 66 cases of this series within a few hours after rupturing the membranes. Besides hastening labour, rupture of membranes has the advantage of decreasing the intrauterine tension and thus reducing the danger of hypofibrinogenaemia from absorption of thromboplastin.

✓ **Artificial Rupture of Membranes and Oxytocic Drip.** In both revealed and concealed accidental haemorrhage, oxytocic drip has a very useful place. It must be stressed that oxytocic drip should never be administered prior to rupture of the membranes because the increase in the intra-amniotic tension following administration of oxytocin will accelerate the absorption of thromboplastin from the retroplacental clot. It is also frequently observed that the uterus fails to respond to the normal amount, 2 units, of oxytocin and a much larger amount is required before the uterus begins to contract.

In revealed accidental haemorrhage, when bleeding continues after rupture of the membranes or, if the uterine contractions are weak, it is necessary to administer an oxytocin drip containing initially 5 units of oxytocin to a pint of 5 per cent dextrose solution. It is frequently necessary to increase the dose of oxytocin to 10 units before the uterus responds.

Oxytocin drip has a most useful place in the management of concealed accidental haemorrhage. Formerly, these cases were treated conservatively for shock and remained undelivered for many hours. In some, spontaneous labour started and the patients delivered vaginally, while those that failed to respond to conservative measures were delivered by caesarean section. The interval of many hours between the onset of abruptio placentae and delivery often resulted in the development of hypofibrinogenaemia. As a result of hypofibrinogenaemia those that delivered died from uncontrolled post-partum haemorrhage or later from anuria.

Severe Cases of Concealed Accidental Haemorrhage. The present day management of these cases is to rupture the membranes

and start an oxytocin drip. Much larger doses of oxytocin are required than those necessary for revealed variety. At the N.W.M. Hospital, as much as 30-35 units were required before the uterus commenced to contract. Shock is treated by giving an injection of pethidine 100 mg. and transfusion of large quantities of properly matched blood.

In severe cases of concealed accidental haemorrhage, fibrinogen level of the blood should be repeatedly estimated and any fall in the level should be taken as an indication for prompt delivery by caesarean section. A ready clinical method is to observe the clot retraction. When blood is collected in a dry test tube it clots and within 15-20 minutes the clot retracts. Normally, the clot remains firm at 37 degrees centigrade at the end of an hour. Failure of clot formation or tendency of the clot to lyse or disintegrate is suggestive of low fibrinogen level. Clinically, hypofibrinogenaemia manifests as bleeding from the gums, haematuria and bleeding from the needle puncture wounds at injection sites. The condition can be corrected by giving fibrinogen. When fibrinogen is not available, administration of multiple strength plasma or transfusion of fresh blood has to be resorted to.

Abdominal Delivery. There now remains an occasional case in which the general condition of the patient continues to deteriorate, where neither spontaneous labour sets in nor is it possible to initiate uterine contractions after artificial rupture of the membranes and a oxytocin drip. The decision to do an abdominal section is difficult. Any further delay may result in the patient dying undelivered. Also the risk of hypofibrinogenaemia increases as time goes on. On the other hand, an abdominal section in a shocked patient carries great risk but there is no alternative. Again, the uterus may fail to retract after caesarean section, and hysterectomy may have to be done to control haemorrhage. An alternative to a hysterectomy is to pack the uterus tightly and suture the uterus over the pack. One end of the pack is pushed into the vagina for pulling out the pack after 8-12 hours. Hysterectomy is rarely performed and, in this series, there was no case in which it was done. Rarely, in a multipara with a dead foetus, the obstetrician may decide to do hysterectomy of the unopened uterus.

Prognosis

Prognosis depends largely on the type of accidental haemorrhage. Although the maternal mortality has been considerably

reduced as a result of better understanding of the causation and pathology, there is very little improvement in the foetal salvage.

In the revealed type, the maternal mortality is practically nil. In the N.W.M. Hospital series, there was no death in cases of revealed accidental haemorrhage. The foetal mortality, however, is about 30 to 40 per cent. As premature onset of labour occurs, the most frequent cause of foetal death is prematurity. When revealed accidental haemorrhage occurs near term, the separation of placenta may result in intrauterine death before the onset of labour. In quite a few, the foetus remains alive until the onset of labour when, as a result of further separation of the placenta, the foetal heart sounds suddenly become inaudible and a stillbirth results.

In the concealed type, the maternal mortality is still as high as 7-8 per cent. Fortunately, the severe type of concealed accidental haemorrhage forms only a small group. Those who respond to conservative treatment and deliver within a few hours survive the immediate dangers of shock and uncontrollable bleeding and also the later risk of death from anuria.

Before the significance of hypofibrinogenaemia was known, valuable time was lost by prolonging conservative treatment. Caesarean section or caesarean hysterectomy after the onset of hypofibrinogenaemia often proved fatal from uncontrollable bleeding.

The severe shock in cases of grave type of accidental haemorrhage is frequently irreversible and ends fatally.

Anuria. Suppression of urine following a severe concealed accidental haemorrhage is a very grave complication. Only a few drops of blood stained urine are passed and the patient gradually becomes uraemic and dies. Until recently, bilateral cortical necrosis was considered as the underlying cause of kidney failure, but recent observation has been that in a number of cases acute tubular necrosis is the cause of anuria.

Puerperal Sepsis. Before the advent of antibiotics, severe puerperal sepsis accounted for some of the fatal cases but, nowadays, it is rare for death to occur from puerperal infection.

The foetal mortality in severe cases is almost cent per cent and there are no means of reducing it.

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SECTION IX

COMPLICATIONS OF THE THIRD STAGE

CHAPTER I

POST-PARTUM HAEMORRHAGE

A variable quantity of blood during the separation of the placenta and following its expulsion is an inevitable accompaniment of the third stage of labour. The normal amount of blood loss during the third stage is variously estimated to be 300 to 500 ml. When it is more than 500 ml. it is termed post-partum haemorrhage. As the quantity of blood lost during the third stage cannot be measured, it is much more important, from a clinical point of view, to be able to know up to what stage the blood loss can be regarded as normal and without any risk to the patient than the amount estimated in measurable quantity.

Post-partum haemorrhage is responsible for many maternal deaths. Statistics from institutions do not reflect the gravity of this complication because severe type of post-partum haemorrhage is seldom encountered in well-equipped institutions having a trained staff. The major factor in precipitating post-partum haemorrhage is the mismanagement of the third stage and the number of deaths occurring from it must be considerable in the rural areas where most of the patients are delivered under unfavourable conditions by untrained, irresponsible personnel. Many deaths caused by post-partum haemorrhage are reported as due to obstetric shock or severe anaemia, and a true estimate of mortality from this condition is therefore not available.

Varieties. Post-partum haemorrhage may be due to atony of the uterus or it may be due to cervical or vaginal lacerations. The former is called *atonic* and the latter *traumatic*. Traumatic post-partum haemorrhage is described in Section 11, Chapter 1.

Atonic Post-partum Haemorrhage

Predisposing Factors. *Mismanagement of Third Stage of*

Labour. The trunk of the baby should not be delivered immediately after the birth of the head, but a little time should be allowed for the uterus to retract. These few seconds are profitably spent in swabbing the mouth and cleaning the eyes of the baby.

When forceps are applied, the head should be delivered gently during a contraction. Delivery during relaxation is fraught with the risk of post-partum haemorrhage.

Signs of the separation of placenta should be well taught to students and pupil midwives, and unnecessarily massaging the uterus or attempts to expel the placenta before it has separated should never be done. The time taken for spontaneous separation of the placenta is variable and, in the absence of bleeding, at least 30-45 minutes must be allowed for natural separation.

Not infrequently, while expelling the separated placenta, the fundus is pushed into the pelvic cavity, in which position it is unable to contract and retract as well as it does when it is in its normal position and continues to bleed. Therefore, after the delivery of the placenta, it must be ensured that the fundus is palpated as a hard globular body in the lower abdomen and, if it is not felt there, it should be pushed up out of the pelvis by vaginal manipulation.

The placenta must be examined after delivery as there may be a missing cotyledon or a succenturiate lobe. A succenturiate placenta is diagnosed when there is a hole in the membranes where torn blood vessels are seen to terminate.

Overdistension of Uterus. An overdistended uterus is likely to remain atonic during the third stage and gives rise to bleeding. In twin pregnancy, the cause of post-partum haemorrhage may be the partial detachment of the large placenta. Sometimes, there are two separate placentas and should one of them separate earlier than the other, bleeding from the placental bed of the separated one will occur.

Placenta Praevia. Even a slight post-partum haemorrhage is likely to be of grave consequence to a woman who is already exsanguinated by an antepartum or an intrapartum haemorrhage. As the lower segment does not contract as well as the upper segment, patients with placenta praevia are more prone to post-partum haemorrhage. Also, the incidence of adherent placenta is greater when the placenta is situated in the lower segment.

Accidental Haemorrhage. When cases of severe concealed accidental haemorrhage are left undelivered for a long time, there

is the danger of uncontrollable post-partum bleeding. Hypofibrinogenaemia and the atonic uterus combine to give rise to severe, often fatal, post-partum bleeding.

Grande Multipara. Due to the relative atony of the uterus in women who have more than five childbirths, post-partum bleeding is a potential complication.

Anaemia. Post-partum haemorrhage in an anaemic patient is a very serious complication. The third stage of labour must be vigilantly conducted and even slight continuous trickle of blood should be promptly checked. A great drawback of post-partum haemorrhage in an anaemic woman is that owing to cardiac insufficiency, large quantities of infusion fluids or blood cannot be given for fear of cardiac failure from sudden increase in the blood volume.

Anaesthesia. Whenever any obstetric operation is performed under general anaesthesia there is likelihood of the uterus remaining relaxed for some time after delivery giving rise to bleeding.

Fibromyomata. Theoretically, multiple intramural fibromyomata should cause irregular uterine action, but in practice a fibromyomatous uterus usually contracts well after delivery. However, when the placenta gets partly attached to a deep intramural fibromyoma, it may remain partly adherent giving rise to post-partum bleeding.

Diagnosis. Atonic post-partum haemorrhage may commence before the expulsion of the placenta or after its expulsion. Bleeding commencing before the expulsion of the placenta is sometimes known as bleeding of the third stage and that occurring after the expulsion of the placenta as *bleeding of the fourth stage*.

It is most important to differentiate atonic from traumatic post-partum haemorrhage. In atonic variety, bleeding occurs when the uterus is soft and relaxed but stops during a contraction. A contraction can be brought on by massaging the fundus and should bleeding stop during the contraction to reoccur when the contraction is over, the diagnosis of atonic bleeding is certain. Traumatic bleeding, on the other hand, continues even when the uterus is contracted.

The uterus, after the expulsion of the placenta, remains tonically contracted but, should bleeding still continue, it is of traumatic origin. The genital canal should be inspected, after inserting a speculum, for any cervical or vaginal lacerations. At the same time, the placenta must be examined to note whether it is complete.

Speculum examination should be routinely carried out after a forceps or a breech delivery.

Treatment

Prophylaxis. The routine injection of ergometrine at the termination of the second stage has considerably reduced the incidence of post-partum haemorrhage. Both, the duration of the third stage and the quantity of blood loss are noticeably reduced. An intra-muscular injection of ergometrine, 0.25 mg., is usually given after a spontaneous vaginal delivery. In an operative delivery under general anaesthesia, 0.25 mg. is preferably given intravenously. Intravenous injection is also a useful prophylactic measure whenever post-partum haemorrhage is anticipated as, when the uterus is overdistended by hydramnios or multiple pregnancy, in placenta praevia, in accidental haemorrhage, and in anaemic patients.

When a patient is already anaesthetised for any aided delivery, manual removal is carried out immediately after the delivery of the child. Under deep inhalation anaesthesia, the uterus tends to relax and bleed. It is a wise rule not to take the patient too deeply under anaesthesia and also to ask the anaesthetist to make her 'light' no sooner the baby is born because bleeding from the relaxed uterus is likely to continue even after manual removal.

When ergometrine has been given intravenously, the attendant should keep his hand on the fundus and no sooner a firm contraction occurs, and that is within half to one minute of the injection, he should quickly test for the separation of the placenta and make a gentle attempt to express it by pressure on the fundus. If this opportunity is not taken advantage of, the lower part of the uterus may go into spasm which will then prevent expulsion of the placenta. When ergometrine has been injected intramuscularly, the effect is not so rapid but, all the same, the attendant must be ready to expel the placenta when it has separated.

Management. There are certain general principles in the management of post-partum haemorrhage. The fundus of the uterus is palpated and, if it is soft and flabby, it is massaged to bring on a contraction. This will succeed in temporarily arresting the haemorrhage and, opportunity is taken of this short respite, to inject one c.c., 0.5 mg., of ergometrine intramuscularly if the bleeding is moderate, or half c.c., 0.25 mg., intravenously if the bleeding

is severe. It is likely that the placenta may have already separated and the gush of blood might have been the result of it. Signs of separation of the placenta are, therefore, looked for and if it appears that the placenta has already separated, gentle pressure is applied to the fundus to expel it. If the placenta has not yet separated, vigorous attempts to express the placenta should not be made. Besides being fruitless, such attempts will provoke further bleeding. A full bladder, reflexly, tends to cause atony of the uterus and therefore the patient should be catheterised. To allay anxiety, morphia $\frac{1}{4}$ gr. or pethidine 100 mg. should be injected intramuscularly.

Seldom, the first gush of blood is so severe as to cause circulatory collapse but, in anticipation of further bleeding, intravenous infusion of 5 per cent glucose in distilled water should be started. This is a very important measure because at this stage the general condition of the patient is satisfactory and it is quite easy to get into a vein. Before starting the infusion, blood should be collected for grouping and cross matching. To wait is to court disaster. It should be realised that the pulse and the blood pressure remain almost unchanged until about 30 to 40 ounces of blood are lost. This satisfactory state of the patient frequently deceives the attendant into complacency. If the blood loss continues further, circulatory collapse suddenly sets in. The pulse becomes feeble, the blood pressure falls and may become unrecordable, the patient becomes cold, clammy and restless. To get into the collapsed vein is now difficult. Unless prompt help is available to do venesection, and this is possible only in a well-equipped hospital with a trained medical staff, the situation becomes extremely grave. The most important fact to bear in mind is that even a slight post-partum haemorrhage is a warning that normal mechanism of separation of the placenta has failed and manual removal is necessary.

The management of cases of post-partum haemorrhage is given separately for bleeding before delivery of placenta and that occurring after the expulsion of the placenta.

Bleeding before Delivery of Placenta. Clinically, three types are met with: (1) A large bout of bleeding, (2) repeated small bouts of bleeding, and (3) continuous slow trickle of blood.

In one large bout of bleeding, a pint or more of blood may be lost. Usually, the bout of bleeding is not so severe as to cause circulatory collapse but, in anticipation of a second bout, manual removal of the placenta is immediately carried out. Should an

anaesthetist be not at hand, manual removal should be done without anaesthesia. A quick and safe substitute for anaesthesia is intravenous injection of 50 mg. of pethidine. As the placenta has already partially separated, manual removal is a quick and easy procedure in these cases. The fear of producing shock to the patient by doing manual removal of the placenta without anaesthesia is unfounded.

Repeated small bouts often mislead the accoucheur. Frequently, after each bout an inexperienced attendant makes vigorous but fruitless attempt to expel the placenta without testing whether the placenta has separated or is still adherent. Such attempts are, both, shock producing and likely to precipitate a large bout of bleeding. It should be the rule that, if the placenta remains adherent after one or two small bouts, it should be manually removed while the general condition of the patient is satisfactory.

Still more deceptive is the slow continuous trickle of blood which occurs when most of the placenta is still adherent. The inexperienced attendant remains faithful to his teaching of waiting for half an hour for the placenta to separate. He fails to appreciate the cumulative effect of slow, continuous blood loss.

Management Outside a Large Maternity Hospital. When post-partum haemorrhage occurs from a partially adherent placenta in a small maternity hospital or in a patient's home, the problem of management of this grave condition becomes difficult. In Western countries, there are 'flying squads' which can be summoned. These squads carry with them blood for immediate transfusion and an experienced person who can do the manual removal on the spot. In India, unfortunately, the facilities of 'flying squads' are not available, even in large cities. One has to rely on ergometrine to prevent further bleeding, and it should be given immediately when post-partum bleeding, however slight, occurs. In fact, prophylactic injection of ergometrine is a necessary safeguard under such conditions. Morphine, $\frac{1}{4}$ grain, should be given and a drip of 5 per cent glucose solution containing 10 units of oxytocin should be started. Bladder is catheterised and the patient is kept warm.

The most appropriate treatment would be to do an immediate manual removal of placenta rather than produce shock by continuing vigorous attempts to expel the placenta by Crede's method. If the attendant is hesitant to do a manual removal, he should immediately rush the patient to a nearby large institution, while the

general condition has not appreciably deteriorated.

Unfortunately, it is all too frequent to witness admission to a hospital in severe shock as a result of delay in transferring the patient. Many of these cases are admitted in an irreversible shock and die in a short time after admission. It is most unwise to transfer a patient in severe shock, and restorative measures mentioned above combined with request for assistance from a hospital would offer a better chance.

There are two methods of removing an adherent placenta: (1) Crede's manoeuvre of expression, and (2) manual removal.

Crede's Method. Crede's method of expressing the placenta has been practised for more than a hundred years, but it cannot be recommended as a safe and certain manoeuvre. Clinical experience is that the attendant frequently loses his morale with the onset of post-partum haemorrhage and makes repeated, fruitless attempts to expel the placenta, each attempt being more vigorous than the previous one. As a result, shock is aggravated. It should, therefore, never be attempted in a patient who is already in shock, and even otherwise not more than one attempt is permissible.

Crede's method appears easy and appealing but in practice it is not so. Unless the patient is thin, the manoeuvre cannot be satisfactorily carried out. The patient is catheterised and the fundus is massaged until it is firmly contracted. In the absence of a contraction, the method will fail and, over and above, there is the danger of acute inversion of the uterus. The four fingers are passed behind the upper part of the posterior surface of the uterus and the thumb is placed over the anterior surface. The uterus is firmly squeezed so that the placenta is separated from its attachment. The uterus is then pushed downwards and backwards, but never so far down as to push it into the pelvis. In practice, no sooner an attempt is made to grasp the uterus, the patient tightens up her abdominal muscles and the attendant loses the grip. All that he frequently does is to push vigorously the uterus downwards and all that results is a gush of collected blood. Crede's method requires knack rather than force, and a crude attempt by a muscular hand is more likely to fail than a gentle and deft attempt by an experienced person.

Many obstetricians prefer to do a final attempt by Crede's method under anaesthesia just prior to manual removal. This is more likely to be successful because the uterus can be better grasped and squeezed when the abdominal wall is relaxed.

Manual Removal of Placenta. Technique. When the operation is undertaken as a prophylactic measure, there is time to take deliberate aseptic measures. The accoucheur should change his gown and put on a fresh pair of gloves. In emergency, all that needs to be done is to rapidly change the pair of gloves.

Whether manual removal should be done with or without anaesthesia and the choice of anaesthesia need clarification. In emergency, when a large bout of haemorrhage necessitates immediate removal of the placenta, it can be undertaken without anaesthesia. Usually, it does not produce any shock and the bleeding stops with firm contraction of the uterus. For manual removal of placenta, an intravenous injection of 50 mg. of pethidine is a good substitute for anaesthesia. Inhalation anaesthesia has the disadvantage of relaxing the uterus. Sodium thiopentone is contraindicated when the patient is collapsed as a result of blood loss.

The bladder is emptied first. The vulva is cleaned with Dettol lotion, the vagina is also swabbed by pure Dettol. Pure Dettol is applied to the whole external surface of the glove. The hand is inserted in the shape of a cone into the vagina. The other hand is placed on the abdomen to control the fundus and keep it steady. An assistant holds the cord taut and the hand in the vagina follows the cord. Usually, a ring-like structure is present at the junction of the lower and the upper segments, and the cone of the hand must pass beyond it to reach the margin of the placenta. Munro Kerr recommends passing the hand inside the membranes and separating the placenta without tearing the membranes. By this way, direct implantation of organisms carried up from the vagina or cervix is avoided. In practice, however, this does not appear to be a special advantage as it requires great gentleness to avoid tearing of the membranes.

When the placenta has partially separated, further separation is easy along the line of cleavage produced by the separated surface of the placenta. Alternatively, the separation is commenced from the lower margin until the detached portion is reached. The fingers are kept flat and close together during separation with the palmar surface towards the placenta so that even if the line of cleavage is missed the fingers would 'dig' into the placenta and not into the uterine wall as would be likely if the fingers are directed towards the uterine wall (Fig. 130). When the whole surface has been separated, the uterus is massaged by the external hand to bring on a contraction. As the uterus contracts, the hand grasp-

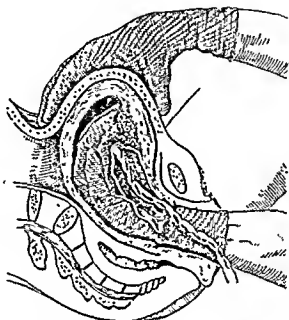


Fig. 130. Manual removal of the placenta.

ing the placenta is withdrawn from the uterus. It is immediately examined for any missing cotyledons. The surface of a manually removed placenta is frequently not as even as the surface of a spontaneously expelled placenta. If there are noticeable gaps in the placenta, the hand is once again smeared with pure Dettol and reinserted into the uterus in search of the missing cotyledons.

The external hand should all the time control the fundus from rising up. It should follow by feel the manipulations of the intra-uterine hand. Correct control by the external hand prevents undue loss of blood during separation and also reduces the danger of perforation of the uterus.

As a rule, slight bleeding occurs during separation, but even if there is brisk haemorrhage the operator must continue to separate the placenta because it is only after its removal that further measures can be taken to control the bleeding.

Morbid adhesion of the placenta is uncommon and, more often than not, reflects the inexperience of the operator. Adhesions are more likely to be in the region of the cornu. Inexperienced operator gets into trouble because he does not keep his fingers flat and together but tries to dig wherever he can with the tips of his fingers. He thus loses the normal line of cleavage.

When a patient is in shock, manual removal of the placenta should never be done as it is certain to prove fatal. The exsan-

guinated patient, with a very low blood pressure, does not bleed and there is no need to promptly remove the placenta. Immediate attention should be paid to treat the shock. Intravenous infusion of Dextran, double strength plasma, or 5 per cent glucose in distilled water is started. Quite often there is difficulty in getting into a vein and venesection will have to be done. Before starting infusion, blood is taken for grouping and cross matching because the sooner blood transfusion is started the better. The first one or two bottles of blood are run in quickly. To raise the blood pressure, adrenal cortical hormone should be given. Once the systolic blood pressure is maintained at 100 mm. Hg, manual removal of the placenta is promptly undertaken.

Bimanual Compression of Uterus. The uterus usually contracts firmly immediately after the expulsion of the placenta, but should it not, bimanual compression of the uterus between the clenched fist in the anterior fornix and the external hand placed behind the uterus will arrest bleeding and, within a few seconds, bring on a strong contraction (Fig. 131).

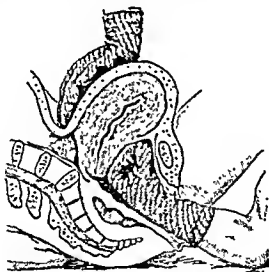


Fig. 131. Bi-manual compression of the uterus.

Bimanual compression of the uterus is a sure method to arrest bleeding which can be used as an emergency measure anywhere and by an accoucheur, a midwife or an interne attending on the case. When the attendant is single handed, bimanual compression of the uterus may well prove a life saving measure. As

a rule, bimanual compression is required for a few minutes only because by then the uterus regains its tone and firmly contracts and retracts, but should the uterus tend to relax it can be kept bimanually compressed until further assistance is obtained. Medical undergraduates and pupil midwives should be taught that even in a well equipped institution, instead of wasting precious time over other methods which are less effective and take some time to apply, bimanual compression must be the first method to promptly arrest further loss of blood.

Bleeding after Delivery of Placenta. Bleeding occurring after the expulsion of the placenta may be atonic or traumatic. It should be noted that it can be both, atonic and traumatic combined, especially when it occurs after an operative delivery. A large bout of haemorrhage may suddenly occur or it may be a slight continuous trickle.

When a large bout of bleeding suddenly occurs, the uterus is briskly massaged and, if this fails to contract the uterus firmly in a few seconds, no time should be lost in bimanually compressing the uterus. These cases are dire emergencies and, in two or three minutes, large amount of blood will be lost which will result in circulatory collapse. Fortunately, with the routine use of ergometrine intramuscularly at the end of the second stage such alarming bleeding is rarely witnessed nowadays.

When massage of the fundus brings on a firm contraction and the bleeding ceases, opportunity is taken of this respite to inject 0.25 mg. of ergometrine intravenously or 0.5 mg. intramuscularly. There is a time lag of about 3-4 minutes after intramuscular injection before the uterus hardens. It is a wise rule to keep a syringe filled with 1 c.c. of ergometrine ready, particularly when the attendant is alone.

Sometimes, the uterus cannot be palpated because it has been pushed down into the pelvis during downward pressure exerted on the fundus to express the placenta. Two fingers are inserted into the vagina and the uterus is pushed out of the pelvic cavity into the abdomen where it is massaged to bring on a contraction.

If a trained assistant is present he should examine the placenta to make sure that it is complete. In the absence of a trained assistant, the attendant should, on no account, leave the patient to examine the placenta, but he should ask some one to bring the placenta to him for inspection. Any missing cotyledons or evidence of a succenturiate lobe having been left behind requires immediate digital exploration of the uterine cavity.

In the majority of cases, bleeding stops with these measures, but to keep the uterus firmly contracted for a prolonged period, an intravenous drip of 5 per cent glucose solution, containing 5-10 units of oxytocin, should be started. The attendant must not leave the patient for at least one hour.

Intrauterine Douche. A hot intrauterine douche is seldom used nowadays because of the danger of introducing sepsis. Instead, a hot vaginal douche is preferred and is equally effective in stimulating contraction of the uterus. The temperature of the water should be less than 115°F. and, before introducing the cannula, the temperature of the water is tested by sprinkling a little water on the back of the bare hand. Douche given with temperature greater than 120°F. is likely to result in sloughing of the vagina. To avoid the risk of air embolism, all air should be driven out from the tube and the nozzle before the nozzle is inserted into the vagina. The douche can should not be more than two feet above the level of the vulva.

Packing of Uterus. Packing of the uterus with sterile roller gauze, 6 inches wide and several yards long, enjoys a varying popularity in different countries. It carries the obvious risk of infection, but with the use of antibiotics the risk is negligible. It is not necessary to keep the pack longer than 6-8 hours because by then the uterus has regained its tone.

It is a desperate measure and there should be no hesitation to pack the uterus, especially when post-partum haemorrhage occurs in unfavourable surroundings. It is most important to pack the uterus tightly and to be able to do so anaesthesia is necessary. Loose and haphazard packing of the uterus is worse than useless because bleeding will continue to occur and will remain concealed above the pack.

Technique. A speculum is inserted and the cervix is held by ring forceps. After applying pure Dettol to the surface of the glove, a hand is introduced through the cervix. There is a constriction demarcating the lower part of the uterus from the upper segment and the hand must be passed beyond the constriction when it will be in the main cavity. This is an important point as an inexperienced person is likely to mistake the lower part as the main cavity and leave the uterine cavity above unpacked. An assistant is asked to place his hand on the abdomen to steady the fundus. One end of the roller gauze is caught in the packing forceps and is passed into the uterus, and the packing is commenced from the



Pl-130. Photomicrograph of placenta accreta. (Courtesy N W M Hospital Museum, Bombay) (p 531)

fundus downwards. After inserting two or three feet, the pack is tightened by the pressure of the forceps and some more is inserted. As the upper part of the uterine cavity is packed the hand is withdrawn into its lower part. As much gauze as can be squeezed into the upper cavity is inserted and then the lower part of the uterus below the constriction is tightly packed. When one roll of about 2 yards is exhausted, the tail end of it is kept outside the cervix and a second roll is pushed in by the side of the first. The tail of each roll is kept loose outside and a count is kept for accounting at the time of removal. Keeping the ends loose is better than knotting the ends to make a continuous length because the knots may get untied during removal and also the knots cause discomfort when they are pulled out. About 6 yards of roller gauze is required to pack the uterus tightly (Fig. 132).

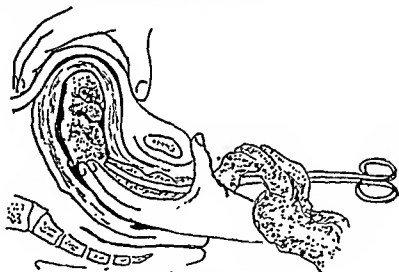


Fig. 132. Plugging of the uterus.

A little blood-stained discharge soaks through the pack by capillary action and is of no significance.

Secondary or Late Post-partum Haemorrhage

Definition. Haemorrhage from the genital tract occurring any time during the puerperium after the first six hours is designated as secondary or late post-partum haemorrhage. It is also called puerperal haemorrhage.

Etiology. The commonest cause of late post-partum haemorrhage is retention of a placental cotyledon or of a succenturiate lobe of placenta. Such retained placental tissues are generally cast off during the early puerperium accompanied by haemorrhage.

These may develop into a placental polyp by deposition of fibrin round the periphery. Placental polyps lead to subinvolution and secondary post-partum haemorrhage.

Subinvolution of the uterus and congestion due to retroversion are very prone to give rise to late post-partum haemorrhage.

Portions of retained foetal membranes are generally cast off during early puerperium without haemorrhage. However, haemorrhage occasionally occurs at the time of their separation.

Infected submucous fibroids are likely to cause secondary post-partum haemorrhage.

Puerperal inversion of the uterus gives persistent bleeding.

Other causes are carcinoma of the cervix, chorionepithelioma, rupture of vaginal or vulval haematoma, and too early coitus. Use of oestrogens to suppress lactation may lead to mild bleeding a few days later.

Lastly, bleeding episodes during the puerperium may occasionally be due to non-genital causes like leukemia, purpura, anticoagulant therapy, etc.

Clinical Features. The haemorrhage may occur any time during the puerperium. The patient may suffer from a large bout of bleeding or repeated irregular haemorrhages or continuous, moderate or mild blood losses. Occasionally, the blood loss may be so severe as to lead to circulatory collapse and shock.

Treatment. Mild cases usually respond to oxytocics given intramuscularly or orally. In all other cases, a uterine curettage is very useful both as a diagnostic and therapeutic measure. In severe cases, blood transfusions are required to replace the lost blood. The specific treatment of the condition will be dictated by the underlying etiology.

CHAPTER 2

RETENTION OF PLACENTA

A placenta which is not expelled within 45 minutes after the birth of the child is considered as a retained placenta. By such a definition, cases in which the placenta has already separated but is incarcerated, as well as those cases in which it is morbidly adherent, are grouped together. For practical purposes, therefore, it is a clinical term in which various pathological processes are included. A retained placenta is likely to give rise to shock, post-partum haemorrhage and a morbid puerperium.

Predisposing Factors

A. Incarceration of a Separated Placenta. *Injection of Oxytocics.* Nowadays, ergometrine is given intramuscularly or intravenously in most clinics immediately after the delivery of the child. Sometimes, powerful annular contraction of the uterine muscle following injection of ergometrine gives rise to a contraction ring in the lower part of the uterus which prevents expulsion of a separated placenta. The ring relaxes within a short time but, if the obstetrician makes forcible attempts to expel the placenta during the spasm, the ring persists for a longer time.

Crede's Manoeuvre. Repeated attempts to expel the placenta by Crede's method are apt to produce a constriction ring and incarcerate the placenta. Instead of shortening the third stage, it is complicated by shock and severe post-partum haemorrhage.

B. Morbidly Adherent Placenta. In the majority of cases, a cause for the adhesion of the placenta to the uterine wall is not known. It is likely that the decidual plate is thin and proper line of cleavage for spontaneous detachment has not developed.

Rarely, there is complete absence of a decidual plate, and the chorionic villi are directly attached to the uterine wall (placenta accreta).

When the villi are in direct contact with the muscle bundles of the myometrium, it is termed *placenta accreta* (Plate 130). When the villi are situated between the muscle bundles, it is called *placenta increta*; and when the branching villi penetrate the thickness of the uterine muscle and come on to the peritoneal surface

of the uterus, it is known as *placenta percreta*. These are mentioned here merely as pathological rarities.

Previous Injury to Uterus. The fibrous scar of a previous caesarean section may, when the placenta is attached to it, cause morbid adhesion in a subsequent pregnancy. As the placenta is attached to the upper segment in most of the cases, morbid adhesions are more likely to form on a classical scar than on a lower segment scar. An anterior placenta praevia is likely to be morbidly adherent to a previous lower segment scar. Spinelli's operation for the correction of an inverted uterus caused morbid adhesion of the placenta in a subsequent labour in one case at the Nowrosjee Wadia Maternity Hospital. A previous difficult manual removal of the placenta may, in a subsequent pregnancy, cause morbid adhesion of the placenta at the previously traumatised site. In clinical practice, however, the incidence of an adherent placenta over a previously injured site is quite small.

Occasionally, a part or whole of the placenta formed over a deep intramural fibroma gives rise to morbid attachment and needs manual removal.

Management

A totally adherent placenta does not give rise to bleeding but one which is partly adherent or one which has separated but is retained frequently causes post partum haemorrhage. The management of cases of adherent placenta with post partum haemorrhage has been described in the previous chapter. Here, only the management of adherent placenta without any appreciable bleeding is given.

When the placenta is retained for more than forty five minutes, it should be considered that the normal mechanism of separation of the placenta has failed and preparations should be made for the removal of the placenta. When an adherent placenta is allowed to remain for more than an hour, shock may supervene even though there has not been serious bleeding during the period. Besides, there is the risk of serious bleeding from delayed partial separation of the placenta. Occasionally, cases of adherent placenta neglected for many hours are admitted without any clinical evidence of shock.

There are three possible methods of separating the adherent placenta: (1) Brandt-Andrew method, (2) Majon-Gabston method, and (3) manual separation.

Separation of Placenta by Traction on Cord (Brandt-Andrew Method). Much has been said about the danger of inverting the uterus by traction on the cord of an adherent placenta, but if properly carried out it is successful in separating the placenta in some of the cases. It is obvious that if the placenta is morbidly adherent, neither Crede's nor cord traction method will succeed in separating the placenta, but, in atleast some, cord traction method will succeed in separating the placenta and thus avoid a manual removal.

The bladder is emptied and the uterus is massaged until it is firmly contracted. An artery forceps is applied to the cord near the vulva for traction on the cord. Before traction on the cord, the abdominal hand grasps the anterior surface of the uterus and pulls it up and keeps it pulled up while traction is being applied to the cord. The placenta frequently separates and is delivered during the first contraction but, should it not, traction is released until next contraction commences.

Majon-Gabston Method. Some obstetricians prefer to separate an adherent placenta by injecting 200-300 c.c. of sterile saline solution into the umbilical vein. This method effects the separation of the placenta by distending the chorionic villi and thereby ballooning the placenta. The sudden increase of placental area separates it from the uterus. This method is cumbersome and usually fails as it is not easy to inject such a large quantity of fluid through the umbilical vein.

Manual Removal of Placenta. In these cases there is not appreciable bleeding and therefore the operation can be performed as a deliberate surgical procedure after summoning the services of an anaesthetist.

Emergency cases of placenta retained for many hours are sometimes treated by cutting the cord at the external os and leaving the placenta undisturbed. This is done when the cervix has closed and an easy manual removal of the placenta is not feasible. Previous to the era of antibiotics, with this form of treatment mild uterine infection was common with profuse foul lochia for several weeks. Nowadays, administration of antibiotics has considerably reduced the risk of infection during the period of slow disintegration of the placenta.

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CHAPTER 3

INVERSION OF UTERUS

Inversion of the uterus is a rare accident in properly conducted cases. The frequency of this complication cannot be accurately estimated. In hospitals, where most of these cases are referred, the figures are obviously high. Probodh Das, from a review of literature in 1940, gave the incidence as 1 in 14,881 deliveries, and that for India as 1 in 23,127 confinements. In the series reported by Das, 83 per cent of the cases were of puerperal origin.

Varieties. Inversion of the uterus may be partial or complete.

In a partial inversion the fundus or the body of the uterus is inverted up to the internal os.

In a complete inversion, the body of the uterus and the cervix are completely inverted.

Etiology. Inversion may occur *spontaneously* or is caused by the improper management of the third stage of labour.

Spontaneous Inversion. It occurs occasionally even in hospital practice, and is due to the atony of the uterus. At the N.W.M. Hospital, during the last five years there were 2 cases of spontaneous inversion following delivery in the hospital. In one case uterine atony was such that inversion tended to recur immediately after replacement and a senior obstetrician had to keep her hand inside the uterine cavity for as long as 20 minutes, before the uterus regained its tone.

If the cord is very short, it may exert traction on the uterus during delivery, and initiate inversion. Such a likelihood is greater if the placenta is attached to the fundus.

Precipitate labour with the woman in the standing position may invert the uterus soon after birth of the child.

Inversion Produced by Mismanagement of Third Stage. Traction on the cord while the placenta is still adherent, or vigorous attempts through the abdominal wall to express an adherent placenta while the uterus is relaxed, are frequent causes of inversion. A placenta adherent to the fundus is much more likely to invert

the uterus. In the series published by Das the placenta was adherent to the fundus in 75 per cent of the cases.

Clinical Features. Two prominent features of inversion of the uterus are, haemorrhage and shock, but they are not invariably present.

Haemorrhage. Severe post-partum haemorrhage sometimes occurs due to atony of the uterus. It may also result from attempts to separate the placenta by traction on the cord.

Shock. In many cases, severe shock is observed, and if there is bleeding as well, it may quickly prove fatal. The shock is of neurogenic origin and is probably due to pull on the infundibulopelvic ligaments, as the ovaries are dragged down into the invagination.

However, shock may be completely absent. A doctor working in Tubercular Sanatorium in Khatmandu, Nepal, one day saw a Nepalese woman walk in to the sanatorium, from a distance of 15 miles. She had delivered two days previously. The uterus was completely inverted and the placenta was still attached to the fundus. A stone had been tied to the cord by the ignorant relatives to keep the uterus out. This case well illustrates the complete absence of shock.

In cases of unexplained shock following delivery, the possibility of partial inversion of the uterus should be borne in mind.

When the uterus is completely inverted, it is outside the vulva and the only condition for which it is likely to be mistaken, is submucous fibromyoma projecting from the cervix. The differentiation is easy, as palpation of the rounded uterus in the abdomen, at once excludes the possibility of inversion of the uterus. In a partial inversion, the uterus may or may not be palpable above the symphysis pubis, but a cup-like depression at the fundus will be palpated.

Sometimes, immediately after the expulsion of the placenta, the uterus cannot be felt in the abdomen. Post-partum bleeding frequently occurs. The absence of uterus in the abdominal cavity and bleeding, closely simulates partial inversion of the uterus. What may actually happen is that, during the efforts to expel the placenta, the uterus is pushed into the pelvic cavity in which position it fails to contract and retract and continues to bleed. The confusion is cleared by inserting the hand in the vagina, when the uterus can be readily pushed up into the abdomen, or the partially inverted fundus can be palpated.

Treatment

Prophylaxis. As this accident commonly results from mismanagement of the third stage, it is very important to stress the proper management of this stage to medical undergraduates and pupil-midwives. The signs of separation of the placenta should be well taught, and in no case attempts should be made to expel the placenta before it has separated. The temptation to exert traction on the cord is great but should not be practised on any account. Repeated forcible attempts to separate and expel the placenta by Crede's method is also likely to invert the uterus.

Once inversion has occurred, oxytocics should not be given as it makes replacement of the uterus much more difficult.

As these cases mostly occur in rural areas, the treatment needs to be discussed (1) in the patient's home, and (2) the management after the case has been transferred to a hospital.

Treatment in Patient's Home. If hospital facilities are readily available, the best treatment is to transfer the patient after giving an injection of 100 mg. pethidine and 200 c.c. of 25% of glucose. In the majority of such cases the placenta is still attached to the inverted uterus. If the placenta is totally adherent, there is usually very slight bleeding and no attempt should be made to detach the placenta in the patient's home. When bleeding occurs from a partially detached placenta, the placenta needs to be removed and this is an easy procedure in an inverted uterus. If the bleeding becomes negligible after removal of the placenta, the inverted uterus is carefully wrapped, and the patient is transferred without making any attempt to replace the inverted uterus.

When transfer to a hospital is not practicable, besides resuscitative measures, an attempt to reduce the inversion should be made if the patient is not in severe shock. Often it is quite easy to replace the uterus before oedema of the constricting cervical portion develops. If the attempt is successful, the attendant should keep his hand in the cavity of the replaced uterus until the uterus firmly contracts. After replacement, 1 c.c. of ergometrine must be given intramuscularly and an intravenous oxytocic drip containing 10 units of oxytocin in 500 ml. of 5 per cent dextrose solution is commenced. If the patient is gravely shocked, it is unwise to attempt reduction and the chief objective must be to resuscitate the patient.

Treatment in Hospital. In many cases, by the time the patient is brought to the hospital, she is in severe shock and is exsanguin-

nated. Besides, by this time, the cervical ring has become oedematous. The first concern is to retrieve the patient from shock. Any attempt to reduce the inversion while the patient is in a state of shock is very likely to cause death.

No attempt to reduce the inversion should be made for some hours after she has completely recovered from shock. Manual taxis is often unsuccessful, and it is better to apply taxis through small roller gauze held in a sponge holding forceps. The broad surface of the roller gauze together with the better leverage of long handles of the sponge holding forceps, is often successful in reducing the inversion through the oedematous ring. Taxis should be applied first at the neck, and as successive portions of the inverted uterus are reduced, the position of taxis is correspondingly shifted. The last part to undergo reduction is the fundus.

Undue force to reduce the inversion is not only inadvisable but carries the risk of tearing the endometrium and the myometrium, resulting in infection of the pulled down adnexae. Therefore, if taxis with reasonable force is unsuccessful, it is better to keep the inverted uterus covered by gauze soaked in mild antiseptic solution and give antibiotics orally or parenterally. When the oedema and infection have subsided and the general condition of the patient has improved, which may take about 3-4 weeks, the inversion is reduced by an abdominal operation, Haultain's or Dobbin's or by Spinell's vaginal operation. Haultain's abdominal operation is easy to perform, and leaves a comparatively small scar on the posterior surface of the uterus. But the selection of the operation will depend on the merits of each case and also on the preference of the operator.

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CHAPTER 4

OBSTETRIC SHOCK

The term obstetric shock is a misnomer as it implies that it is a clinical entity different from shock met with in medical or surgical practice. Except for a few conditions peculiar to obstetrics, such as amniotic fluid embolism and abruptio placentae, the three general factors, trauma, haemorrhage or exhaustion, either alone or in combination, play a prominent role in the causation of obstetric shock. Not infrequently, the term is loosely applied and obstetric shock is given as the cause of death without proper evaluation of the underlying obstetric complication responsible for the shock. It is possible to arrive at a cause of the shock either clinically alone or by autopsy, but in an occasional case a cause cannot be discovered even after a most careful autopsy.

In India, some inevitable contributory factors have to be taken into account. Nutritional anaemia, not infrequently of an alarming degree, is prevalent and even the strain of a normal labour is shock producing and more so when labour is complicated. Absence or inadequate prenatal supervision is also an important contributory factor. Domestic practice is in the hands of untrained women, 'dais', and many cases of irreversible type of shock, as a result of their ignorant and irresponsible practice, are witnessed.

It should be remembered that shock following ordinary surgical procedures and that occurring during or following childbirth are frequently not comparable. As a result of dehydration and exhaustion of a prolonged labour, the patient is already in a state of shock so that when difficult obstetric procedures are performed, the superadded shock of surgical trauma, loss of blood and administration of anaesthesia frequently lead to a state of irreversible, fatal shock.

The various factors causing obstetric shock are described under (1) shock during pregnancy, (2) shock during labour, (3) third stage complications, (4) post-operative shock, and (5) anaesthesia.

Shock During Pregnancy

Abortion. Profuse bleeding, in an inevitable incomplete abor-

tion, causes circulatory collapse. Criminal interference is an important and frequently fatal cause of shock. Severe trauma, with or without perforation of uterus, haemorrhage, and severe pain due to the operation performed without anaesthesia or under improper anaesthesia, all contribute towards shock. Severe infection, especially by cl. Welchii, produces profound shock.

Ectopic Pregnancy. Here the main cause is circulatory collapse due to severe intraperitoneal bleeding. Shock is a negligible factor and no sooner bleeding is arrested and the blood loss replaced, there is remarkable rapid improvement in the condition of the patient.

A similar circulatory collapse is seen in the uncommon cases of perforating 'malignant mole'.

Torsion. Twisting of the pedicle of an ovarian cyst or a pedunculated subserous fibromyoma during pregnancy, sometimes, produces severe shock but recovery is rapid after operation. The degree of shock depends on the number of twists and the suddenness with which torsion occurs.

A more marked degree of shock is produced when a pregnant uterus undergoes torsion on the cervix. This complication is rare and closely simulates abruptio placentae.

Torsion of the pedicle of an enlarged spleen during pregnancy produces a very complicating picture. It produces a severe state of shock and the author had a case of 34 weeks' pregnancy in which the twisted pedicle of the spleen was found during caesarean section. Motashaw reported a case of torsion of the spleen during pregnancy.

Rupture of Previous Caesarean Scar. A classical caesarean scar ruptures more frequently than a lower segment scar. The giving way of the scar is often gradual and profound shock occurs only after extrusion of the foetus and the placenta into the peritoneal cavity. The condition of the patient deteriorates rapidly, more so if there is associated profuse intraperitoneal haemorrhage.

Abruptio Placentae. In concealed accidental haemorrhage, the degree of shock is out of proportion to the retroplacental blood extravasation. Sudden overdistension of the uterus is an important factor in producing shock. The shock is partly due to peritoneal irritation from multiple fissuring of the peritoneal coat of the uterus and partly from the collection of blood in the peritoneal cavity and the broad ligament. In the rare cases of concealed accidental haemorrhage, complicated by rupture of the uterus, shock is most

profound.

Toxaemia and Hypertension. Apart from abruptio placentae, severe shock sometimes occurs in fulminating pre-eclampsia and more so in eclampsia. In eclampsia, the exhaustion from repeated fits aggravates shock. The frequent observation of a remarkably low blood pressure in severe pre-eclampsia or eclampsia is a sign of the onset of shock and is of grave prognosis. To the inexperienced, it is a misleading sign.

Shock During Labour

Prolonged Labour. It is a relative term in more than one way. A prolonged labour that has been neglected is more shock-producing than a properly supervised labour of the same duration. In the former case, lack of nourishment and fluids produces acidosis. Sleeplessness, unrelieved pain, mental anxiety are important contributory factors towards shock. As mentioned previously, such neglected conditions are prevalent in domiciliary midwifery in many parts of this country.

Prolonged labour is more common in primigravidae and in the grand multiparae. In primigravidae, the incidence of hypotonic uterine action, mild cephalopelvic disproportion, and occipito-posterior positions are more common than in multiparae. These causes singly or, as is common in primigravidae, in combination, largely contribute towards shock when labour is conducted by inexperienced or untrained persons under unfavourable obstetric conditions.

Grand multiparae are particularly dangerous obstetric patients. First of all, it is often taken for granted that since she has delivered several babies normally, this labour will be equally uneventful and supervision is relaxed with dire consequences. The incidence of malpresentations is high in grand multiparae and, when the malpresentation remains neglected, rupture is the final event in producing profound shock in an already exhausted case.

Rupture of Uterus. Now and again, rupture of the uterus occurs in obstetric institutions supervised by trained staff but, as the accident is detected soon after its occurrence, prompt measures are taken before dangerous shock prevails. But, when rupture occurs in a neglected case, the previous exhaustion, the transfer of the patient from distant places to obstetric institutions and the loss of valuable time therein, produce dangerous shock from which it is difficult, and frequently impossible, to retrieve the patient.

A quarter of a century ago, difficult intrauterine manipulations, like internal versions, craniotomy, decapitation and embryotomy, were performed for effecting vaginal delivery and, not infrequently, rupture of the distended, thin lower uterine segment was precipitated by such difficult manoeuvres. Today, such difficult procedures are seldom performed in hospitals and instead caesarean section is elected even though the foetus is moribund or already dead. This changed trend is possible nowadays because of easy availability of blood and antibiotics to combat infection. But, in distant places, such manoeuvres have to be performed and that too under unfavourable surroundings and by persons not adept in undertaking such difficult operations and shock is inevitable.

Irrespective of the cause of rupture, profound shock always sets in either immediately after rupture or after some time. In majority of such cases, labour has been unduly prolonged and neglected. Intraperitoneal bleeding is usually negligible and does not materially influence the shock, but an extensive broad ligament haematoma from tearing of uterine veins is not uncommon and does aggravate the shock.

A ragged tear from a sudden 'explosive' rupture is more shock producing than a linear tear in the lower segment. The shock in the former is akin to 'crush' injury following accidents. Upward extension of a cervical or vaginal tear into the lower segment is also shock producing.

Haemorrhage. Antepartum, intrapartum and post-partum haemorrhage, each by itself but more when in combination, produce fatal circulatory collapse. Haemorrhage in a previously anaemic patient often weighs against her. Even a comparatively small haemorrhage in an anaemic patient may prove fatal.

Not infrequently, the manipulations employed for arresting haemorrhage precipitate shock. Internal podalic version in placenta praevia, and manual removal of the placenta for post-partum bleeding are the two conditions which may cause fatal shock in a woman who is already in a state of circulatory collapse. The more frequent employment of blood transfusions and caesarean sections for placenta praevia are present day helpful trends towards reducing shock. Manual removal of placenta is shock producing when it is delayed until the patient is exsanguinated. Manual removal can be safely carried out without any anaesthesia or after giving 50 mg. pethidine hydrochloride intravenously.

Third Stage Complications. The shock of sudden, severe atonic

post-partum bleeding in an otherwise normal delivery is a purely circulatory collapse and can be effectively treated by replacing the blood volume.

It should, however, be stressed that at times extensive lacerations of the cervix or of the vagina do not give rise to immediate severe postpartum haemorrhage but only to a slight continuous ooze. If these lacerations remain undetected, the patient goes into a state of shock within the first few hours after delivery. The shock in such cases is a combination of blood loss and syndrome akin to 'crush injury' in other parts of the body. It is, therefore, a wise rule to do a speculum examination in all cases of instrumental delivery, spontaneous breech delivery of a large baby, and precipitate labour. Whenever temporary recovery from shock occurs after resuscitative measures including blood transfusions, but blood pressure falls once again and other signs of shock reappear, the obstetrician must examine for local trauma and, if that is excluded, a laparotomy should be performed. In a number of cases an undiagnosed rupture, with or without intraperitoneal collection of blood or a broad ligament haematoma will be found.

Retained Placenta. Shock in cases of retained placenta develops from several causes. When the placenta remains completely adherent, *placenta accreta*, there is no haemorrhage and in many of them shock does not occur.

The shock in retained placenta is largely due to haemorrhage and forcible attempts to deliver an adherent placenta. A large bout of bleeding from a partially detached placenta frequently precipitates immediate shock but more dangerous is the slow continuous trickle of blood. The inexperienced are deceived into complacency because the general condition of the patient remains satisfactory for some time. When the blood loss reaches a certain point, shock sets in and manual removal at that stage becomes a dangerous procedure.

It should therefore be an inflexible rule that whenever placenta fails to detach within 45 minutes after completion of the second stage, it should be considered that the natural mechanism of separation of the placenta has failed and manual removal should be performed. When ergometrine has been injected prophylactically after termination of the second stage, the placenta should separate within a few minutes and, if it fails to separate, the attendant should proceed to do manual removal.

It is usually stated that a placenta retained for more than an

hour without any bleeding is likely to lead to shock, but there is little evidence to substantiate the statement. Shock is more likely to be due to bleeding and forcible attempts to expel the placenta.

Acute Inversion of Uterus. In most of the cases, inversion of the uterus results from mismanagement of the third stage, but, occasionally, spontaneous inversion does occur in institutions having a well trained nursing and medical staff. The genesis of severe shock in these cases is not clear. In part it is due to associated blood loss but mainly it is due to the sudden pulling down of the ovaries and stretching of the nerves in the broad ligament.

When the inversion is complete, the inverted fundus is seen outside the vulva and there is no difficulty in diagnosis, but when the inversion is partial, the diagnosis cannot be made on abdominal examination alone. The absence of the uterus in the abdomen is not conclusive evidence as often the uterus is pushed into the pelvic cavity during expulsion of the placenta. As previously stated, it should be a rule to do a vaginal and speculum examination in all cases of unexplained shock and it is only then that a partial inversion can be detected.

Treatment of Obstetric Shock

The treatment is broadly divisible into two parts: (1) treatment of shock, and (2) treatment of the underlying cause. It is an infallible obstetric rule not to treat the underlying cause whilst the patient is still in profound shock. Therefore, resuscitative measures should always have precedence and, later, when the general condition shows signs of improvement, treatment of the underlying cause is undertaken. The prognosis of obstetric shock is much more favourable in hospital practice with readily available skilled assistance than in a patient's home. It is unfortunately all too common to witness women in profound shock being brought to the hospital from long distances only to succumb soon after admission. A long journey is most dangerous to a patient in profound shock and it is very urgent to have emergency squads, as in Western countries, to give the necessary resuscitative treatment in the patient's home.

Treatment of Shock. The first principle in the treatment of shock is to give an intramuscular injection of 1/6 gr. (11 mgm.)

of morphia. By this means relief is obtained by the patient from her apprehension and painful stimuli. The foot of the bed is raised and the patient is covered by warm blankets. If hot water bags are applied, care should be taken to prevent them from coming in direct contact with the skin as, owing to the poor peripheral circulation and absence of normal local reflexes, severe burns may occur.

The most important resuscitative measure is to maintain the level of systolic blood pressure to at least 90 mm. Hg. In severe shock, the veins collapse and it may not be possible to get into a vein and venesection of a vein near the ankle is necessary. Even when it has been possible to start intravenous infusion without venesection, it is advisable to do a venesection and insert a polyethylene catheter into the proximal end. Through a small needle inserted into a vein, it is possible to infuse fluids but flow of blood through a small bore needle becomes difficult. For this reason, venesection in a collapsed patient is a necessary measure.

When circulatory collapse is due to severe loss of blood, transfusion of suitable blood will soon revive the patient. At least half an hour is required to obtain Rh tested, grouped and cross-matched blood. To save valuable time, it is best to get the blood of all patients during antenatal supervision tested for Rh factor and blood group. In extreme emergency, it is best to start the first transfusion of O, Rh negative blood, and the subsequent ones according to the Rh factor and blood group of the patient.

Even when shock is not due to severe loss of blood, blood transfusion should be given because some loss of blood is inevitable in all confinements. Those cases in which the level of the blood pressure does not rise with treatment, or when it rises for a short time and falls again, the possible causes of shock are, continuing intra-abdominal bleeding from rupture of the uterus or from deep lacerations of the vaginal canal extending into the broad ligaments. Another cause is partial inversion of the uterus. In these cases, prompt bold measures are necessary. Blood should be rapidly pushed in either directly from 20 c.c. syringe or by applying positive pressure through a bulb and tube attached to the transfusion bottle. The services of a skilled anaesthetist and an experienced obstetrician should be commissioned. A rapid vaginal and speculum examination is done to exclude a local cause and, if that be present a laparotomy is undertaken.

Pulmonary Embolism

Death resulting from pulmonary embolism has been reported in almost every branch of medical and surgical practice. This grave complication is predisposed to by certain conditions peculiar to obstetrics. Nelson in his review has stressed that neither the period of pregnancy nor the mode of delivery is without the danger of this dire complication.

Pulmonary embolism is a composite term and includes, at least, three pathological conditions. Until recently, pulmonary embolism was considered to be due to a thrombus in the majority of cases, but recent studies have brought to light two other pathological conditions, air embolism and amniotic fluid embolism. Nixon suggests the term gas embolism instead of air embolism, as in some instances another gas, such as oxygen or carbon dioxide, is introduced into the circulation. Generally, the cause of death in maternal mortality reports is given as pulmonary embolism and, as a result, it is difficult to determine the incidence of each of the three pathological states causing it.

Air Embolism

Etiology. During Pregnancy as a Complication of Abortion. Air embolism during pregnancy is most commonly associated with the attempts at criminal abortion. Nelson collected 98 fatalities in criminal abortion, all established at autopsy. The common devices employed for producing abortion are intrauterine injection of air, water, soap solution, abortifacient pastes by means of syringe or catheter and bulb. The air is either injected directly or displaced by the fluid into the uterine sinuses from whence it enters the large pelvic veins, inferior vena cava and into the right side of the heart.

Gas Embolism during Pregnancy in Non-abortive Cases. Nixon records 14 fatal cases of which 6 were due to powder insufflation of the vagina, as a therapy for *Trichomonas Vaginalis* vaginitis. The vaginal introitus was occluded by the insufflator and, as a result, air under pressure was introduced into the vagina and from there into the uterus.

Air Embolism Complicating Labour and Delivery. The commonest cause amongst the reported cases was placenta praevia. The combination of open sinuses in the lower uterine segment and the

intrauterine manipulations facilitate entrance of air into the circulation. When lower segment caesarean section is performed for an anterior placenta praevia the possibility of this complication should be kept in mind. The incision then opens up the large uterine sinuses during the operation.

In manual removal of the placenta, the air is likely to be sucked into the uterine sinuses during its separation.

Rupture of the uterus is an important cause and air enters into the circulation through the torn uterine sinuses and through uterine blood vessels in the broad ligaments.

In abruptio placentae the uterine sinuses are already torn during the separation of the placenta and the increased uterine tonus facilitates the entrance for air.

Air Embolism in Puerperium. There are two groups of cases. In the first group air embolism occurs within the first 24 hours after delivery and almost all of them prove fatal. The probable etiological factors are intrauterine douche and packing of the uterus.

In the second, or the late puerperal group, the cause was employment of knee-chest position as a prophylaxis against puerperal retroversion and subinvolution. On resuming the horizontal position the air in the vagina suddenly enters through the patulous cervix into the uterine sinuses.

Clinical Features. Death may occur soon after the onset, or after an interval of 12 to 24 hours. The two main clinical features are cerebral manifestations and a sudden collapse in the peripheral arterial circulation with concomitant increase in venous pressure.

The sequence of events is quite sudden. The patient tries to rise or speak but falls back unconscious. If the patient is not under anaesthesia convulsions occur regularly with marked cyanosis.

Arterial circulation is totally arrested but the heart continues to beat for a time. Auscultation at this stage reveals the classical "mill wheel" or "water-wheel" sound from the churning of air and blood. According to some, this typical sound can be heard by other persons in the same room. If auscultation of this typical murmur is missed and cardiac arrest occurs, the final clinical picture may be indistinguishable from amniotic fluid embolism or thrombo-embolism.

Treatment. Since the accumulation of air in the right heart is the chief pathological feature, aspiration of air is the most logical procedure. Nelson quotes the reported cases by Halselhorst, Stall-

worthy, Martin and Postlethwait, and Shires and O'Banion in which the patients survived after aspiration of air. Even as little as 10 to 20 ml. of air aspirated has been life saving. The overloaded venous system immediately supplied blood to the right ventricle as soon as the air trap is released and normal cardiac action is restored.

Nicholson and Crenan have put forth an emergency schedule, mainly for the use by anaesthetists. (1) Discontinue the source of gas, (2) place the patient in head-down, left-lateral position, (3) administer oxygen, (4) aspirate the right ventricle through the chest wall if the heart is beating or, if cardiac arrest has occurred, immediate thoracotomy and the direct aspiration of gas from the right ventricle, (5) since the venous system is loaded, blood transfusion through a vein is not likely to benefit, but arterial transfusion might prove helpful.

Amniotic Fluid Embolism

The clinical syndrome of amniotic fluid embolism was first described by Meyer in 1926, but the classical paper by Steiner and Luschbaugh, in 1941, created the present-day interest in this problem. Angillon, Andrus, Grayson and Race reviewed, in 1962, the 60 reported cases and added 5 of their own.

Clinical Features. It occurs mostly in elderly multiparae who have had prolonged difficult labours and birth of oversized infants. The onset of symptoms is sudden. Without any apparent reason, acute respiratory distress develops, associated with shock. Death occurs soon after the onset of symptoms. In the few cases that survived, hypofibrinogenaemia with haemorrhages occurred.

Autopsy Findings. The condition is definitely diagnosed by an autopsy. Pulmonary oedema is a common autopsy finding, with the finding of granular emboli in the pulmonary arterioles which contain leucocyte and meconium, lanugo, mucin and/or squamous cells.

Blood from ovarian and uterine vessels is allowed to stand. In amniotic fluid embolism, the blood settles in three layers. The bottom layer is composed of cells, the middle layer is the buffy coat, and the upper layer contains amniotic debris. The upper layer is used for smear and stain to identify particulate matter of amniotic fluid.

Treatment. Oxygen by positive pressure; papaverine hydrochloride for reflex vasospasm, atropine-like agents for cardiac de-

pressor reflexes and, if the patient survives the initial shock, fibrinogen and whole blood.

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SECTION X

INJURIES TO MOTHER AND FOETUS DURING CHILDBIRTH

CHAPTER 1

MATERNAL INJURIES TO GENITAL TRACT

Cervical Lacerations

Tears of the cervix cause profuse post-partum bleeding. Cervix may tear during spontaneous labour but more frequently during an operative delivery. The tear is most frequently on the left side, but cervix may lacerate in any other direction. The cervix may be torn in one place or at several places.

Etiology. During Spontaneous Delivery. The cervix may be torn during the birth of an excessively large foetus. The after-coming head in a breech presentation is likely to lacerate the cervix. Vigorous 'bearing down' efforts by the patient before the cervix is fully dilated is likely to tear the cervix as a result of sudden forcible expulsion of the head through it. Occasionally, the scar of a previous vaginal hysterotomy gives way in a subsequent childbirth, but the tear being fibrous is unlikely to cause severe bleeding.

Operative Delivery. During a difficult forceps delivery, the cervix is liable to tear. Bad tears of the cervix extending into the lower uterine segment are witnessed when forceps delivery is attempted through an incompletely dilated cervix. Multiple incisions through the cervix, as recommended by Duhrssen, to allow immediate forceps delivery may extend upwards and cause profuse bleeding. The cervix may tear during any intra-uterine manipulations.

The cervix should, as a routine, be inspected after a breech delivery and after all operative deliveries. The cervix after the birth of the baby is soft, crumpled and hangs loose into the vagina. To inspect the circumference of the cervix, it is necessary to hold it by ring forceps in the 3, 6, 9 and 12 o'clock positions.

Treatment. Bleeding cervical lacerations must be immediately sutured. Even those that are not bleeding should be sutured as otherwise there is a risk of local infection which may spread along the lymphatics of the cervix to the pelvic tissues.

To have the field clear, a length of roller gauze is inserted into the uterine cavity. The bleeding is checked by the pressure of ring forceps applied to the torn edges. An Allis or Morrison's forceps is applied a little above the apex of the tear, and the edges are brought together by interrupted sutures of No. 1 chromic catgut, starting from the apex downwards. When the tear is deep, it may not be possible to reach the apex straight away, and the first interrupted suture is passed as high as possible and is kept long. By traction on this suture and by downward pressure on the fundus from above, the part of the tear above the first traction suture is brought together by one or more interrupted sutures (Fig. 133).

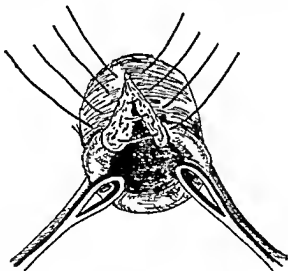


Fig. 133. Suturing of cervical tear.

Colporrhexis

In 1875, Hugenberger coined the word "kolporrhexis" to describe the condition in which there is more or less complete rupture of the vault of the vagina with little or no injury to the cervix or the lower uterine segment. Tears, originating in the cervix and extending into the fornices, are not considered as cases of colpor-

rhexis. There is scant reference to this condition in the literature as well as in obstetric textbooks. In 1927, Gamble reviewed the literature and stated that "a total of approximately 120 cases of colporrhexis have been reported to date". In 1954, Menon from Madras reported 5 cases of colporrhexis. Menon, in 1962, reported 164 cases of rupture uterus; among them, there were 20 cases of colporrhexis.

Etiology. The causes of colporrhexis are not properly understood. The conditions giving rise to colporrhexis differ in individual cases. Unskilled use of forceps resulted in colporrhexis in cases described by Campbell and Louis, and Fothergill. It resulted during attempts at internal version in some of the reported cases. Apart from these traumatic causes, the etiology and mechanism of spontaneous colporrhexis is not known.

Misdirected uterine axis, as in labour after ventrifixation of the uterus or labour in multipara having a markedly pendulous abdomen, may be the etiology in some of the cases. In Gamble's case, a seventh para with pendulous abdomen developed posterior colporrhexis during labour soon after she got out of bed and got up. With the patient in the recumbent position, the uterine axis was not misdirected but, when she stood up, the uterine contractions pushed the head against the stretched posterior vaginal wall causing rupture of the posterior fornix. According to Freud's theory, quoted by Gamble, the mechanism in such cases is that the fully dilated cervix retracts above the presenting part which then exerts direct pressure on the distended upper part of the posterior vaginal wall resulting in rupture.

All 5 cases reported by Menon occurred in multipara having good previous obstetric history. The presentation was vertex in 4 and face in one. In 3 cases in which colporrhexis occurred under *supervision in hospital, the labour was proceeding normally and the pains were rather weak.* There was no indication to terminate labour and suddenly, before vaginal delivery could be effected, colporrhexis occurred. All the patients had bad pelvic floor relaxation with varying degrees of cystocele and rectocele. Menon expresses the view that a vagina supported normally on all sides by the musculo-fascial sling is capable of withstanding considerable pressure but, if the supports of the vagina are weakened, it is likely that the distension and pressure of the presenting part in a prolonged labour and, sometimes, even in a normal labour might give rise to colporrhexis.

In all the five cases reported by Menon, there was anterior colporrhexis which is rather unusual because in most of the reported cases colporrhexis was posterior.

Clinical Features. The clinical features are similar to those met with in rupture of the uterus. Shock is usually greater in uterine rupture. Unexplained sudden vaginal bleeding is more frequent in colporrhexis than in rupture of the uterus.

A correct diagnosis may be made on vaginal examination, but usually the case is diagnosed as rupture of the uterus and colporrhexis is diagnosed only at operation.

Treatment. In multigravidae, even in the absence of maternal or foetal distress, the second stage should not be unduly prolonged. Immediate laparotomy is necessary. As these patients are multiparous, total hysterectomy is the best form of treatment. Apart from multiparity, hysterectomy is often necessitated because the rent is difficult, or may even be impossible, to suture satisfactorily.

Spontaneous Annular Detachment of Cervix

Spontaneous annular detachment of the cervix during labour is not so rare a complication in countries where universal organised obstetric care is not available. Comparatively very few cases have been reported. Upto 1947, Ingraham and Taylor were able to find only 54 reported cases to which they added one of their own. Jeffcoate and Lister reviewed the literature upto 1952 and reported 6 further cases. Motashaw reported 3 cases from the N.W.M. Hospital, Bombay, and Lakshmi reported a case from Madras (Plates 131, 132).

Causation. The exact cause for the annular detachment of the cervix is not known but certain clinical observations suggest ischaemic necrosis at the cervico-vaginal junction as the cause of detachment.

Most of the reported cases have occurred in primigravidae over the age of 30, which itself suggests functional rigidity of the cervix as the underlying cause. Cephalopelvic disproportion does not appear to be a causal factor as in the majority of cases the head was low down in the pelvic cavity. The cervix is taken up but the external os remains thick and fails to dilate more than one or two fingers. The average duration of labour in the reported cases was 58 hours and the continuous pressure of the head at the cervico-vaginal junction for such prolonged period led to ischaemic necrosis.

Clinical Features. The first stage of labour is prolonged for more than 48 hours. The head is felt to be low down in the pelvic cavity. The uterine contractions are strong. On repeated vaginal examinations, a thick, external os is palpated. After many hours of labour, slight persistent bleeding commences. Either spontaneous delivery occurs with the detached cervix giving an appearance of a small 'cap' on the head, or the detached cervix appears at the vulva, and the delivery needs to be completed by application of forceps.

Treatment. There is no bleeding after delivery from the raw margin of the cervix and no active treatment is necessary. On speculum examination, some weeks after delivery, the cervix appears almost normal.

Tears of Vagina

The vagina may be lacerated on one or both the sides, and the tears may be in any direction. The lacerations are generally longitudinal, but transverse lacerations sometimes occur at the vault.

Etiology. The most common cause of lacerations of the vagina is forceps delivery. Attempts to rotate the head by forceps are particularly prone to cause extensive tears of the vagina. Spontaneous or forceps delivery in the face to pubis position is likely to tear the posterior vaginal wall. Sharp bony specules of a perforated head may injure the vagina during subsequent passage of the head along the vaginal canal. It should be realised that the genital canal is oedematous when labour is prolonged, and tears readily during any manipulation.

Clinical Features. Lacerations of the lateral vaginal wall may extend upwards and give rise to a broad ligament haematoma, or may extend downwards and result in haematoma of the ischio-rectal fossa. Deep tears of the posterior vaginal wall cause profuse bleeding from the injured blood vessels in the recto-vaginal septum. Sometimes, unexplained shock following delivery is due to lacerations of the vagina which, in the absence of bleeding, escape detection. Shock in these cases is akin to that observed following 'crush' injury of other regions.

Treatment. Lacerations of the vagina are sutured by mattress or continuous locked chromic catgut stitches. When profuse bleeding occurs, it may not be possible to suture the tear, and the vagina is tightly packed to arrest the bleeding temporarily. Later, after

giving one or more blood transfusions, the patient is anaesthetised and proper suturing is carried out. The lacerated margins sometimes retract considerably and they should be held by Allis or Morrison's forceps before commencing suturing so that no gap is left behind.

Neglected lacerations cause local genital infection with profuse purulent discharge during puerperium. Healing occurs by secondary intention with varying degrees of paravaginal fibrosis. Extensive fibrosis sometimes constricts the vagina to such an extent as not to allow even a finger to pass through it.

Injuries To Vulva

Bruising and slight laceration of the hymeneal tags and the fourchette inevitably occur in all primigravidae. Perineal tears are clinically divided into four types according to the structures of the perineum involved in the tear.

The *first degree* tear involves a small distance of the posterior vaginal wall and the perineal skin. It should, however, be remembered that, sometimes, only the posterior vaginal wall is lacerated while the perineal skin remains intact. These 'hidden' first degree lacerations are frequently missed because there is no external evidence of a tear. A small haematoma forms at the site which on healing leaves a lax vaginal outlet with eversion of the lower part of the posterior vaginal wall. It should, therefore, be the rule to inspect the perineum carefully for 'hidden' tears and, when found, the thin skin over it must be cut so that proper suturing can be done.

The *second degree* of perineal tear extends to a varying length from the fourchette and may extend as far as the skin of the anus without involving the sphincter ani.

The central tendon, where the deep transverse, the bulbocavernosus and the ischiocavernosus are inserted, is lacerated. The depth of the perineal wound is 1 to 2 inches and the decussating fibres of the puborectalis muscles are also frequently involved.

The posterior vaginal wall is torn for some distance but, frequently, the posterior vaginal wall lacerates on the sides leaving a tongue-like central portion. The lacerations on the sides are usually unequal in length extending higher on one side.

The *third degree* of perineal tear is the most serious, as it involves the anal sphincter and lacerates the anterior rectal wall

to a varying degree. It gives rise to incontinence of faeces. If it is not properly sutured immediately, the posterior vaginal wall and the anterior rectal wall adhere together without any intervening tissue of the perineal body (Plate 133).

The fourth type, known as the 'central' tear of the perineum, is extremely rare; in it, the baby delivers by making a rent through the perineal body leaving intact a bridge of tissue anteriorly. Before commencing repair, the bridge of tissue anterior to the central tear must be divided so as to convert it into a second or a third degree perineal tear.

Etiology. The routine practice of performing episiotomy in primigravidae has considerably reduced the incidence of perineal tears. Multigravidae, in whom a previous perineal tear or an episiotomy has been properly sutured, behave like primigravidae, and often need an episiotomy in subsequent childbirths. Unless this is done as a prophylactic measure, the perineum tears at the site where it was previously sutured. The previous practice of allowing the bead to pound on the perineum until it stretched excessively without tearing was looked upon with pride. Little was it realised that the loss of the elasticity of the perineum permanently weakened the pelvic floor. Even today, some midwives look upon the obstetrician with disdain because he does timely episiotomies in most of his cases.

Not infrequently, the obstetrician is successful in avoiding a perineal tear during the delivery of the head, but a tear occurs during the delivery of the shoulders.

Spontaneous face to pubis delivery causes a bad perineal tear because of the large foetal diameters of the head stretching the vulval outlet. Even more damaging is a persistent face to pubis forceps delivery in which the head comes out of the vulval outlet unexpectedly.

Breech delivery in primigravidae usually produces a bad perineal tear, but the routine employment of an episiotomy has eliminated the incidence of bad perineal tears.

Repair Of Perineal Tear:

First Degree of Perineal Tear

Steps: (1) If the skin is still intact it is incised. The haematoma is evacuated and the lacerated margins of the posterior vaginal wall are defined.

(2) The posterior vaginal wall is sutured by No. 0 chromic continuous suture (Fig. 134).

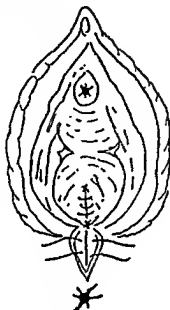


Fig. 134. Suturing of first degree perineal tear.

(3) If the perineal wound is not deeper than half an inch, it is brought together with the skin by one or two vertical mattress sutures of linen.

Second Degree of Perineal Tear

Anaesthesia. Infiltration of the region by 1 per cent solution of local anaesthetic is done. The needle should be at least 3 inches long and the tissues beneath the torn vagina are infiltrated. On either side, the perineal muscles are infiltrated by inserting the needle beneath the cut edges. The skin of either side is anaesthetised by injecting the solution into the subcutaneous tissues.

Steps. (1) The vulva is retracted on either side by fingers, and the extent of the tear in the vagina is inspected. To get a clear field, the upper part of the vagina is plugged by roller gauze. The apex of the tear is held by Allis forceps and the first stitch must be applied carefully and preferably $\frac{1}{4}$ inch above the apex. Severe oozing is likely to occur from a small left out area at the

apex. The torn vagina is sutured by continuous locked stitches of No. 0 chromic catgut.

If the tear in the vagina is on both the sides, each side is sutured separately upto the apex of the central tongue-like portion of the vagina and from there by a continuous suture which includes edges on either side (Fig. 135).



Fig. 135. Suturing of second degree perineal tear.

(2) The torn perineal muscles are next sutured by interrupted No. 1 chromic catgut sutures. One, two or even three layers may be required depending on the depth of the wound. While passing the needle, the index finger of the left hand should be kept in the wound to press the rectum back. Neglect to take this precaution may result in the formation of a recto-vaginal fistula from inclusion of the rectum.

(3) The skin is sutured by vertical mattress sutures.

Repair of Complete Perineal Tear. For a satisfactory repair, general anaesthesia is preferable to regional anaesthesia.

Steps. (1) The edges of the torn anterior rectal wall are approximated by interrupted sutures of No. 0 chromic catgut. The stitches take a bite of rectal musculature without including the rectal mucosa. Stitching should be commenced about half an inch

above the torn margins so as not to leave a small opening which may later form a recto-vaginal fistula.

(2) The bulbous ends of the anterior half of the anal sphincter are defined and a suture of No. 1 chromic catgut is passed through the bulbous ends and, when tied, the sphincter is reconstructed. A second stitch, lateral to the first, is inserted and, when tied, relieves tension on the first stitch.

(3) The posterior vaginal wall is stitched by a continuous locked No. 0 chromic catgut.

(4) The torn perineal muscles are approximated by interrupted stitches of No. 1 chromic catgut. If the tear is deep, two or more layers of muscular stitches may be required.

(5) The skin is approximated by vertical mattress sutures.

Haematoma of Vulva. It occurs from effusion of blood during labour. It frequently extends along the lateral vaginal wall and may obstruct labour by occluding the vaginal canal. Effusion of blood may be spontaneous or may follow rupture of a varicose vein. During labour, it comes on suddenly with intense pain and tenderness. In a short time, it may increase to a large size and, if it bursts, severe haemorrhage occurs (Plate 134).

Usually, a vulval haematoma is localised but, sometimes, a deep seated collection may track upwards to the pelvic cellular tissues or downwards into the ischio-rectal fossa. Besides severe local pain and tenderness, retention of urine occurs in some cases.

Treatment. Haematoma of vulva is treated by rest and cold applications. If it obstructs vaginal delivery or rapidly increases in size, free incision is necessary. Timely evacuation prevents massive necrosis of the tissues.

Genital Fistulae

Urinary Fistulae. Fistula following a prolonged and difficult labour is still common in India but the number of large and complicated fistulae following childbirth is gradually decreasing and it is to be hoped that with the progressive development of the health services in rural India during the successive five-year plans, fistulae following difficult labour will become as uncommon as in European countries. Genital fistulae occur more frequently in Northern India and other regions where the purdah system is still prevalent. These orthodox women prefer home deliveries by untrained 'dais'. It is inevitably a common condition amongst the poor population and

Lawson Tait's remarks pronounced many years ago are worth quoting: "I have already said that operations for vaginal fistulae are rarely paid for, except in gratitude, because the patients are nearly always poor. I must have operated on two or three hundred cases and I have not yet been remunerated to an extent which would pay for the instruments I have bought for the purpose."

In Chasser Moir's series of hundred cases of vesico-vaginal fistulae, 36 resulted from trauma during childbirth and 64 after gynaecological surgical operations.

Treatment. Spontaneous Healing. It has been clinically observed that fistulae, resulting from obstetric trauma tend to heal spontaneously within the first three months. Even large ones which appear hopeless sometimes heal spontaneously in a few weeks. To assist healing a self-retaining catheter is kept in and urine is continuously drained. The position of the patient does not appear to influence healing. Puerperal sepsis should be combated by antibiotics as chances of healing are few in presence of local genital infection.

Those that do not heal spontaneously require an operation. Operative repair should be deferred for at least three months after delivery because, apart from the possibility of spontaneous healing, it is necessary to allow time for involution of the tissues following delivery.

Faecal Fistulae. The majority of faecal fistulae result from a complete tear of the perineum. A recto-vaginal fistula sometimes occurs as a result of sloughing of the posterior vaginal wall.

Treatment. Usually recto-vaginal fistula is situated in the lower third of the vagina. Repair is commenced by cutting through the perineal tissues as far as the fistula and the subsequent steps of the operation are the same as in the repair of complete perineal tear.

A small recto-vaginal fistula in the lower third of the vagina may be closed by a circular incision around the fistula, dissecting the tract and closing the rectum by a purse-string suture to invert the rectal wall around the fistula.

Recto-vaginal fistula in the upper part of the vagina is treated by making a vertical incision into the posterior vaginal wall from the posterior fornix upto the perineum. The two vaginal flaps are dissected and the rectum with the fistula is exposed. When there is surrounding scar tissue the rectum is mobilised as far as is necessary. The rectal opening is closed by a purse-string suture.

levator ani muscles are united and then the posterior vaginal flaps are sutured together.

Combined Urinary and Faecal Fistulae. Sometimes obstetric trauma is so severe that combined vesico-vaginal and recto-vaginal fistula results. Both the fistula can be repaired at the same time or the vesico-vaginal fistula is repaired first and when that has healed the faecal fistula is repaired. When a large vesico-vaginal fistula fails to heal after several attempts at repair, the faecal fistula is first repaired and then the ureters are transplanted into the sigmoid colon.

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PI-131. Annular detachment of the cervix. (Courtesy
N. W. M. Hospital Museum, Bombay). (p. 552).



PI-132. Annular detachment of the cervix. (Courtesy:
N. W. M. Hospital Museum, Bombay). (p. 552).



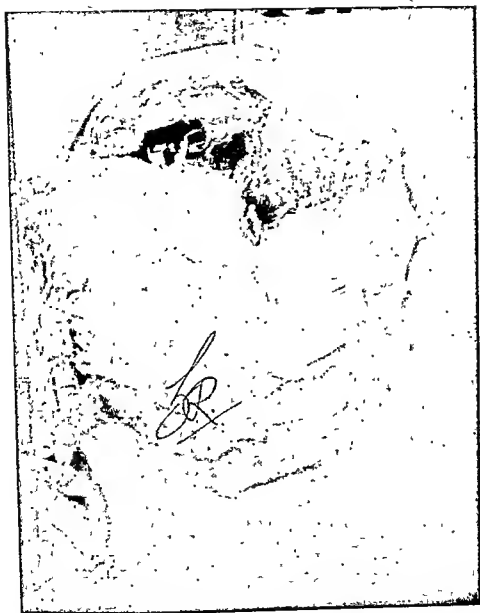
Pl-133. Complete perineal tear. (Courtesy: N. W. M. Hospital Museum, Bombay). (p. 555).



*Pl-134 Haematoma of vulva. (Courtesy.
N. W. M. Hospital Museum, Bombay).
(p. 558).*



r1-135 Rupture of previous classical caesarean scar. (Courtesy: N. W. M. Hospital Museum, Bombay). (p. 562).



Pl-136. Transverse rupture of the upper segment (Courtesy: N W. M. Hospital Museum, Bombay) (p. 563).



Pl-137. Transverse rupture of the lower segment. (Courtesy: N. W. M. Hospital Museum, Bombay). (p 563).

CHAPTER 2

RUPTURE OF UTERUS

Rupture of the uterus is a grave obstetric complication. In the majority of cases this complication is the result of obstructed labour, but the uterus may also rupture during pregnancy. Its occurrence in well-equipped institutions is high, because it is there that the mismanaged, neglected cases are referred.

Incidence Given by Different Authors

Author	Incidence of rupture
Harris & Angwa, Kenya, Africa	1 : 117
Swami & Patel, Baroda, India	1 : 200
Delfs & Eastman, Johns Hopkins, America ..	1 : 1010
Bak & Hayden, America	1 : 1829
Patel & Parikh, N.W.M. Hospital, Bombay ..	1 : 1257
Subhadra Devi, Visakhapatnam, India ..	1 : 590
Menon M. K. K., Madras, India	1 : 415

These wide variations merely reflect the available obstetric facilities in their respective areas.

Parity. It is well known that spontaneous rupture of the uterus is uncommon in a primipara even if the labour is obstructed, because a primiparous uterus goes into inertia when faced with an unsurmountable obstruction. On the other hand, rupture of the uterus in women of high parity is common, particularly in the group of sixth para and above because a multiparous uterus goes into tetanic contraction when obstruction cannot be overcome. In the N.W.-M.H. series, there was only one case of rupture of a primiparous uterus and that too resulted from a railway accident.

Age. The age incidence in the N.W.M.H. series was low in women below 20 years of age, because in this age group there is preponderance of primiparae. Rupture of the uterus occurred, most frequently, between the ages of 31 and 35 because many women of high parity fall into this group.

Booked and Emergency Cases. That rupture of the uterus is

commonly the result of neglected, obstructed labour is well emphasised in the N.W.M.H. series. The incidence in booked cases was as low as 1:1815, whereas in emergency admissions it was as high as 1:726.

Varieties of Uterine Rupture. It is customary to describe uterine rupture as *complete* or *incomplete*. A complete rupture involves all the coats of the uterus including the peritoneum. In an incomplete rupture, the peritoneum is not torn. In a complete rupture, the foetus often escapes into the peritoneal cavity with diffuse intra-peritoneal haemorrhage. An incomplete rupture is likely to cause broad ligament haematoma. The division into complete and incomplete rupture is academic because the clinical features of the two are indistinguishable and the management is the same for both.

The etiology and clinical features of rupture of the uterus during pregnancy or early labour differ considerably from rupture occurring after a prolonged or obstructed labour, and therefore it is necessary to consider rupture of the uterus at these periods separately.

Rupture Of Uterus During Pregnancy

Etiology. The scar of a previous caesarean section is more liable to rupture during subsequent pregnancy or labour than any other scar on the uterus (Plate 135). A vertical scar of a previous classical caesarean section ruptures more frequently than the transverse scar of a lower segment caesarean section. Should the placenta be situated anteriorly over the site of the incision, the stitching and the subsequent healing of such a ragged wound is never satisfactory and, as a result, there is a greater likelihood of subsequent rupture.

The rapid reduction in the size and alternating contraction and relaxation of the upper segment during the immediate post-natal period prevents uninterrupted healing of a vertical scar. On the other hand, the transverse scar on the relatively passive lower segment heals firmly. Rupture of a lower segment scar during pregnancy is rare and occurs much more frequently during labour because any obstruction to labour causes progressive and excessive stretching of the lower segment.

The present trend is to suture the lower segment ruptured during labour. Healing of such a ragged or probably infected wound

Causes of Rupture of Uterus

RUPTURE OF UTERUS

is likely to be weak and the chance of such a scar giving way in a subsequent pregnancy has got to be borne in mind.

A vertical hysterotomy scar is akin to a vertical classical caesarean section scar, and therefore a hysterotomy during pregnancy is preferably performed through a transverse incision over the lower part of the uterus. Myomectomy scar, even when the cavity has been opened, rarely ruptures in a subsequent pregnancy.

Other rare causes of weakening of the uterine wall are manual removal of a very adherent placenta or a vigorous curettage, especially of a puerperal uterus.

Severe trauma, a blow, a kick, a fall on the abdomen or a road, or railway accident may cause traumatic rupture of the uterus.

Clinical Features

Frequently, in a commencing rupture of a previous caesarean section scar during pregnancy, the general condition of the patient remains unchanged for some time. The rupture remains clinically 'silent' until the foetal sac is expelled into the peritoneal cavity. Soon after, the patient goes into a state of shock. Due to the fibrous nature of the scar and as the uterus firmly contracts after expulsion of the foetal sac there is very little intraperitoneal bleeding except in cases where the placenta is situated over the site of rupture.

As the scar begins to stretch and the amniotic sac herniates through the scar, abdominal pain and tenderness, localised over the upper segment, are present. Incessant vomiting and abdominal distension are prominent clinical features in some of the cases.

Rupture Of Uterus After Prolonged Labour

In India, emergency admissions for rupture of the uterus after a neglected labour are unfortunately still common due to lack of proper obstetric facilities in the rural areas. As labour becomes prolonged, there is more and more vertical as well as side to side stretching and thinning of the lower segment with the Bandle's retraction ring rising up to or even above the level of the umbilicus (Plates 136, 137).

Etiology. The important predisposing causes of rupture of the uterus during labour are, (1) abnormal presentations, (2) cephalopelvic disproportion, (3) misuse of oxytocins, and (4) trauma, acci-

1, Scar of caesarean & upper seg
2, myomectomy scar

563

3, Excessive force by blow, kick, fall, a fall on sharp pt.

4, Prolonged & obstructed labo

dental or during obstetric operations. Occasionally, a pelvic tumour obstructing the parturient canal, or a previous weakening of the uterine wall by manual removal of an adherent placenta, has been followed by rupture of the uterus. Rarely rupture of the uterus occurs in a case of concealed accidental haemorrhage.

Abnormal Presentations. The uterus occasionally ruptures in cases of neglected mento-posterior or persistent occipito-posterior positions.

9, multipara
Neglected transverse lie is the commonest malpresentation resulting in spontaneous rupture. Among the series of 41 cases at the N.W.M. Hospital, there were 9 cases of transverse lie. As spontaneous delivery of a full-term foetus is impossible with a transverse lie, the lower segment continues to distend and finally ruptures, either spontaneously or during the attempt to perform an internal version. *10, Instrumental delivery & fully dilated*

A neglected brow presentation is not an infrequent cause of rupture. The rupture may be spontaneous or as a result of unsuccessful attempt to deliver by forceps.

Cephalopelvic Disproportion. A neglected case of major degree of disproportion will always result in rupture of the uterus. In hospital practice, such cases are submitted to caesarean section, either as an elective procedure or soon after the onset of labour. In rural areas, where prenatal supervision is either not available or is imperfect, rupture of the uterus is an ever present danger.

More deceptive are the cases of mild disproportion. In multiparae whose previous deliveries have been spontaneous, a normal delivery is taken for granted and antenatal supervision and intranatal vigilance are relaxed and this sometimes happens even in well-equipped institutions. It should be remembered that, due to increase in the weight of the foetus in successive pregnancies, a previous minor disproportion may become major in a subsequent delivery. Grande multiparae are at all times dangerous obstetric cases and neglect of a minor degree of disproportion may easily result in rupture.

Misuse of Oxytocins. Formerly, when fractional intramuscular doses of oxytocin were given to augment labour pains without proper estimation of the cause of delay, rupture of the uterus was common. The inexperienced found it a convenient method in protracted labour, especially in multiparae who had previous normal labours. The recent introduction of sparteine sulphate by the intramuscular route needs as much supervision as the other oxytocins.

The present day extended use of intravenous oxytocin drip also needs constant supervision. Two and a half units to a pint of 5 per cent dextrose solution should be employed as it is a safe dose. The advantage of intravenous oxytocin drip is that its flow can be regulated or even stopped if uterine contractions become very strong.

Trauma. Barring few cases of accidental injuries, traumatic rupture during labour is due to ill-advised or poorly executed obstetric manoeuvres.

Internal version performed in a multipara, when all the liquor has drained out and the uterus has tightly gripped the body of the foetus, carries great risk of rupture of the uterus. In protracted labour, even the gentlest manipulation is likely to precipitate an extensive rupture.

Instrumental delivery should never be undertaken before the cervix is fully dilated, and is a very common cause of rupture of the uterus. This is particularly true for forceps, and attempts to drag the foetus out through an incompletely dilated cervix is likely to result in extensive lacerations of the cervix extending into the lower segment. Destructive operations, like craniotomy or decapitation, are likely to precipitate rupture of the overdistended lower segment. Therefore, the present trend is, wherever facilities are available, to deliver cases of protracted labour by caesarean section even though the foetus is dead or moribund.

Clinical Features. It is true that uterine rupture is usually the result of inadequate and inefficient obstetric care. However, the uterus is likely to rupture even under good obstetric supervision, especially if the gravity of the clinical picture of threatened rupture is not realised. It is, therefore, important to discuss the clinical features of a threatened rupture, and that of an already ruptured uterus separately.

Clinical Features of Threatened Rupture. Increasing maternal distress in cases of obstructed labour is manifested by restlessness, rapid pulse and constant pain over the lower part of the uterus. The contractions become strong and frequent, and, finally, tetanic.

The signs of impending rupture are: (1) tenderness over the lower segment even after catheterisation of the bladder, (2) gaseous distension of the bowels with the uterus pushed to one side, (3) a rapidly rising Bandl's "retraction ring", which appears as an oblique groove, is an indication of vertical stretching of the lower segment, (4) the vertical elongation of the lower segment also pulls up the bladder attached to it and, as a result, tiny blood vessels in

the region of the trigone are torn. Blood-stained urine is therefore a further evidence of overdistension of the lower segment.

On abdominal examination, the uterus is tender on palpation, particularly the lower part. The outline of the uterus is felt on all sides, an important sign which indicates that the uterus has not yet ruptured. In early stages of a protracted labour, the uterus continues to contract and relax, and the foetal parts can be palpated. When labour is allowed to prolong still further, the uterus, in its attempt to overcome obstruction to labour, goes into tetanic contraction. The uterus now remains persistently hard and contracted, through which it is impossible to palpate the presentation or position of the foetus.

On vaginal examination, the vagina is hot and dry, which suggests maternal dehydration. The cervix is partially dilated and oedematous. The presenting part is not well applied to the cervix and is at a distance from the cervical rim. As the cervix is not well applied and taken up, it is commonly described as hanging loose in the vagina. More important, in a case under observation, is the 'reformation' of the vaginal portion of the cervix as this only occurs when labour is prolonged and its progress arrested. The sutures and fontanelles, in a prolonged labour, are obscured by the formation of a caput and the diagnosis of the malpresentation is difficult.

Clinical Features of Already Ruptured Uterus. The patient, who was distressed with strong contractions, suddenly becomes quiet as after rupture uterine contractions cease. Signs of severe shock soon appear and the pulse becomes very rapid, of low volume, and there is a fall of blood pressure which may become so low as to be unrecordable.

On abdominal palpation, the outline of the uterus cannot be defined clearly all around. Loss of contour and a depressed area where the uterus has given way can be palpated in most cases.

In those cases in which the foetus lies in front of the uterus with its back posterior, the foetal parts can be easily palpated and appear very superficial. The hard retracted uterus is felt as a separate mass by the side of the foetus. But, in those cases in which the uterus is situated in front of the foetus, abdominal palpation is inconclusive as then neither the separate swellings can be felt nor is rupture suggested as the foetus is lying behind the uterus. Sometimes, when the foetus is in front of the uterus with its back anterior, the smooth surface of the back gives an impression that

the uterine contour is still undisturbed. In such doubtful cases, the marked shock, cessation of uterine contractions and unaccountable vaginal bleeding are sufficient evidences for abdominal exploration.

On vaginal examination, when the presenting part is found to have receded from its former position in the pelvis, the diagnosis of rupture is established, but rupture can occur without recession of the presenting part.

External and Internal Haemorrhage. As a rule, there is a small amount of external bleeding following rupture. Internal bleeding is not always severe and depends on the site of rupture. Rupture along the lateral wall is likely to tear the thin uterine veins with the formation of a broad ligament haematoma.

Treatment

The treatment of this grave complication is not as straightforward as in the West, where organized obstetrics has considerably reduced the gravity of this accident. Unfortunately, in India, rural obstetrics is still primitive and inadequate, and rupture of the uterus in neglected cases still accounts for many maternal deaths. In large cities where the majority of women are delivered in well-equipped institutions, manned by trained staff, prompt and skilful treatment is readily available whenever this accident occurs. In rural areas, where this complication occurs more frequently, an inexperienced and ill-equipped medical attendant is called upon to perform difficult vaginal operations upon a shocked patient with grave consequences. Frequently, deeply shocked patients have to travel long distances for admission to a properly equipped maternity institution and, in spite of all the facilities, it frequently becomes impossible to retrieve them from shock.

The treatment, when the patient is admitted to a well-equipped hospital, necessarily differs from that carried out of necessity in outlying areas.

The treatment is divided for clinical purposes into three parts:

- (1) Prophylaxis of uterine rupture.
- (2) Treatment of impending rupture.
- (3) Treatment of rupture.

Prophylaxis of Uterine Rupture. With few exceptions, like spontaneous rupture during pregnancy, uterine rupture is usually preventable. The best prophylaxis against uterine rupture is adequate obstetric care. Malpresentations should be diagnosed during

pregnancy or as early in labour as possible, and should be either corrected or adequately treated otherwise. A cephalopelvic disproportion should be detected at the earliest possible opportunity and the degree of disproportion should be properly assessed. Cases of malpresentation, disproportion, previous caesarean section, and the cases in whom oxytocics are required should invariably be entrusted to a senior obstetrician. Operations, like internal version and instrumental deliveries, should always be performed by a competent obstetrician or under his supervision. In any case, it is a sound practice to do an intrauterine examination after any manipulation or instrumental delivery. Neglect to examine the lower genital tract and the uterine cavity for likely trauma following operative delivery often leads to delay in the diagnosis until shock supervenes and valuable time is lost.

Treatment of Impending Rupture

Management in an Institution. In a well equipped institution, majority of cases of imminent rupture are nowadays submitted to caesarean section even though the foetus is moribund or already dead. Formerly, an abdominal delivery in a prolonged, neglected and already infected case carried high maternal mortality and, as far as possible, a vaginal delivery was performed. This changed trend is mainly due to the easy availability of blood and the safety afforded by antibiotics. There is ample clinical evidence to justify an abdominal delivery. On opening the abdomen, it is frequently noticed that the lower uterine segment has either critically thinned out or has already begun to give way and intrauterine manipulations in such an overdistended lower segment would almost certainly precipitate rupture of the uterus. An abdominal operation for rupture after a difficult vaginal delivery produces severe shock which often proves fatal. A caesarean section undertaken straightaway in these cases is, therefore, safe and rational in the present changed conditions. A neglected transverse lie is nowadays submitted to a caesarean section. This is emphasised from the records of the N.W.M. Hospital where, during the last three years, not a single decapitation was performed. Similarly, many cases of persistent brow, persistent mento-posterior and deep transverse arrest are delivered by caesarean section.

There are, however, some cases where an attempt to deliver vaginally is justifiable. When the head has descended up to the

level of the ischial spines and the cervix is fully dilated, an attempt is made to correct the malposition and deliver by forceps. A tentative forceps delivery should always be undertaken in the operation theatre so that, if the vaginal attempt fails, an immediate abdominal section can be performed.

Management outside an Institution. In domiciliary practice in rural areas all the conditions are unfavourable. The patient is usually dehydrated and very likely infected by the unskilled attendant. The medical practitioner, who is called upon to attend the emergency, is not proficient to perform skilfully such obstetric operations as internal version, craniotomy and decapitation. He is still further handicapped by not having ready at hand resuscitative measures, particularly blood transfusions.

These operations require skilful anaesthesia and a trained anaesthetist is not usually available in rural areas. Even when he is successful in delivering the patient vaginally, it is more often than not at the expense of rupturing the uterus. The maternal mortality under such condition must necessarily be appalling. When the uterus ruptures under such condition all that can be done is to pack the rent and the uterine cavity.

Treatment of Rupture

Every case of ruptured uterus is in varying degree of shock and prompt resuscitative measures must be undertaken immediately. The patient, on admission, is preferably kept in the operation theatre where better facilities are available than in the ward. An injection of morphia $\frac{1}{4}$ gr. or of pethidine 100 mg. is given. Blood is grouped and crossmatched and request for 1,000 to 2,000 c.c. of blood for immediate transfusion is made. As the veins are collapsed, it is necessary to do a venesection and put a polyethylene catheter in the proximal end.

When to Operate? When rupture occurs in an institution, it is immediately diagnosed and prompt resuscitative measures are taken before severe shock sets in. No sooner the operation theatre is ready an operation is performed. The prognosis is good and majority of patients recover from this grave complication.

When rupture occurs following a prolonged neglected labour at home, the patient is admitted in grave shock. Frequently, it is a journey of several hours from the home to the hospital. The shock of a prolonged labour followed by rupture is still further

aggravated by the long journey. Unfortunately, the valuable assistance of a 'flying squad' is not available in India. In spite of medical measures and rapid transfusion of blood, the condition often remains unchanged or deteriorates. To perform an abdominal operation on such a gravely shocked patient is hazardous, but at the same time by waiting for recovery valuable time is lost. None too often, the shock is irreversible and, in spite of all efforts, it proves fatal.

In some cases, the condition of the patient improves and the blood pressure rises to 90 or 100 systolic, but the improvement is not maintained and the pressure once again falls and other features of shock reappear. In this type of case, the abdomen must be opened immediately as the second fall in pressure indicates progressive intra-abdominal haemorrhage.

Operative Treatment. On opening the abdomen, the dead foetus and the placenta are removed. The ruptured uterus is brought out of the abdominal incision to inspect the site and extent of rupture. The utero-vesical peritoneum is usually torn in lower segment rupture but, if it is intact, it is cut across the front of the lower segment. The lower edge of the cut peritoneum is lifted up and the base of the bladder is inspected for trauma. Sometimes, the bladder is intact but one or more blood vessels at the base of the bladder are torn. The bleeding points are ligatured. There is frequently a broad ligament haematoma. Loose blood clots are removed but no attempt is made to dislodge attached ones. Sometimes, torn uterine vessels are seen and they are ligated, especially when it is decided to repair the rupture and preserve the uterus.

After the foetus and the placenta have been removed, a decision must be taken as to whether hysterectomy should be performed or the rent should be sutured. The great advantages of hysterectomy over suturing are that the bleeding is effectively controlled and the risks of infection avoided to some extent.

The indications for hysterectomy are: (1) irregular tear extending from the lower segment laterally upwards involving the big blood vessels, (2) an explosive rupture in any other part in which the tissues are so damaged that it is impossible to find tissue for satisfactory suturing. Any attempt to suture is foiled by the stitches cutting through the fragmented edges, (3) a grossly infected case. A subtotal hysterectomy is done for tears extending upwards from the lower segment and a total for tears extending downwards into the cervix and the vagina.

The indications for suturing the rent are: (1) ruptured caesarean scar being clean cut can be satisfactorily sutured. The fibrous scar must be excised and the freshened edges are re-sutured in two layers, (2) as a less shock producing procedure for patients in profound shock. A quick single layer of mattress sutures through healthy tissue beyond the ragged margin is done.

A recent study at the N.W.M. Hospital, Bombay, of 13 cases of previous rupture in whom 21 pregnancies subsequently occurred there were 2 cases of previous upper segment and 11 cases of previous lower segment rupture.

Four pregnancies occurred in the 2 cases of previous upper segment rupture. Two of these had a second rupture, one was terminated at the 16th week for threatened rupture and one had an elective caesarean section.

Seventeen pregnancies occurred in 11 cases of previous lower segment rupture. Only one had repeat rupture. Two had vaginal deliveries and 14 had an elective caesarean section.

This study shows that a previous lower segment scar is quite reliable as opposed to classical scar. Though two cases had a vaginal delivery it is hazardous to risk a vaginal delivery after a previous rupture. All pregnancies following a previous rupture should be terminated by elective caesarean section.

Maternal Mortality. The three major causes of death are shock, haemorrhage and peritonitis. Shock claims the largest number of deaths. Frequently, the shock is so severe that death occurs soon after admission before any treatment can be given. The degree of shock is related to the extent of neglect during labour, the unsuccessful intrauterine manipulations carried out, the time interval between rupture and starting of resuscitative measures, and long journey from distant places to the hospital.

Haemorrhage is a major factor in 'explosive' rupture involving the main uterine vessels. Shock plus haemorrhage is of grave prognosis and unless promptly treated results in death.

Peritonitis used to be a very common cause of death among those that survived the immediate shock but since the antibiotic era, peritonitis can be successfully treated in a large number of cases.

Foetal Mortality. Foetal mortality is over 90 per cent. Only in those few cases where rupture of a previous caesarean scar is diagnosed early that the foetus has a chance of survival.

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CHAPTER 3

ASPHYXIA NEONATORUM

Asphyxia neonatorum means anoxia of the new born infant. It should, however, be known that, in the majority of cases, it is not a condition suddenly developing at birth, but is the continuation of asphyxia developed during labour, or in some instances, asphyxia commencing at term, before the onset of labour.

It should also be known that asphyxia neonatorum is a relative term. Anoxia developing during labour may be so severe and prolonged as to result in the birth of a stillborn infant, or the infant may be born alive as shown by the beating of its heart, but succumbs within a few minutes, because it fails to breathe. In its lesser degree, the infant starts respirations at birth, but after a period ranging from a few hours up to five days, it succumbs. In a still lesser form, the infant survives and after a normal development until three or four years, manifests signs of cerebral damage in the form of spastic paralysis of one or more limbs, inco-ordination of speech or defective hearing. Nixon states that in Britain "atleast 1 in 50 children has an impaired mental status, sometimes due to neurological defects acquired during pregnancy or labour and 1 to 1000 babies has a defect of hearing". It is, therefore, evident that many foetal and infant lives are either lost as a result of anoxia or, from those that survive, a number of them have an acquired neurological disorder.

The delay in the onset of respiration at birth may be due to the failure on the part of the medulla to initiate respiratory movements. On the other hand, the respiratory centre in the medulla may be normal in its functions, but the lungs may fail to become aerated either because the airway in the upper respiratory passages is blocked by meconium, blood or mucus, or the alveoli may fail to expand.

Etiology

The etiology of asphyxia neonatorum falls into two groups: (1) injury to the central nervous system, and (2) respiratory distress syndrome. In many cases the two are associated and it is difficult

to differentiate the cause and effect of either on asphyxia neonatorum.

Injury to Central Nervous System

The three causes of intrauterine injury to the central nervous system are: (1) Prolonged intrapartum anoxia, (2) intracranial haemorrhages, and (3) narcotics employed during childbirth. The factors which influence each of these groups are materially different and are therefore separately described.

Prolonged Intrapartum Anoxia. It may result from compression of the umbilical cord, abruptio placentae, pressure of the presenting part on a placenta praevia, or intrapartum haemorrhage.

The cord may be compressed during vaginal delivery after prolapse, or due to tightening of a loop or loops round the neck.

Abruptio placentae may be a complication of toxæmia, or result from vigorous contraction and retraction of the uterus, or traction on a short cord. The pressure of the presenting part on a first or second degree placenta praevia may occur either during spontaneous vaginal delivery, pressure of half breech after pulling down a leg, traction on the scalp by a Willett's forceps, or pitocin drip.

Intrapartum haemorrhage may be from a placenta praevia or from retroplacental clot in abruptio placentae.

Intracranial Haemorrhages. Intracranial haemorrhages fall into two major categories. (1) Those produced by birth trauma and associated with dural tears and subdural haemorrhages. (2) Those caused by anoxia—ventricular and subarachnoid haemorrhages. Anoxic type of haemorrhage occurs principally in premature infants.

Traumatic Haemorrhages. Moulding. The skull is composed of two types of bones; the non-rigid vault and the rigid base. The vault is composed of pliable platelike bones, the frontal, the parietals and the membranous part of the occipital bone. They are *loosely joined by the frontal, the sagittal and the lambdoid sutures.*

The alteration in the shape of the head is partly brought about by the bending of the bones and partly by the overlapping of the bones along the sutures. Alteration in the shape of the vault by bending is chiefly due to the bending of the parietals and the frontal. The occipital bone is more rigid and hardly bends. The displacement is mostly of the occipital bone at the lambdoid suture. The plate-like part of the occipital bone has a hinge-like joint bet-

ween it and the basal portion which allows forward or backward movement. It will be evident that a decrease in the antero-posterior diameter of the vault is brought about by the forward displacement of the occipital bone under the parietals at the lambdoid suture. This occurs during labour in vertex presentations and in the after-coming head of the breech. Increase in the antero-posterior diameter is by displacement backward of the plate of the occipital bone with widening of the lambdoid suture. In face and brow presentations there is an increase in the antero-posterior diameter. This process of alterations in shape is known as 'moulding'.

The pliable bones of the vault are reinforced by four sheets of dura mater, the *falx cerebri*, the two halves of the *tentorium cerebelli* and the *falx cerebelli*. These septa have a protective function in labour by preventing excessive alterations in the shape of the cranial vault. The important venous sinuses course along these dural septa. Any movement of the bones of the vault is transmitted to, and is resisted by, the attached septa. These dural septa are not of equal strength and thickness throughout. The particular parts of the septa which are likely to have to bear the greatest strain are strengthened by aggregation of fibrous tissue. On sound principles of mechanics, the dura is considerably reinforced by fibrous tissue along the attachment of the *falx cerebri* to the superior surface of the *tentorium cerebelli*. A second point of reinforcement of the dura mater is at the torcular Herophilli where the superior longitudinal, the two lateral and the occipital sinuses meet (Figs. 136, 137).

During the passage of the head through the birth canal, it is subjected to the action of compressive forces which are the resultant between the force of uterine contractions and the resistance of the maternal passages. The head is therefore in a state of stress during labour. This stress is met by moulding of the head. Moulding, upto a point, is a necessary process even in the easiest labour, without which many a foetus could not be born. Excessive moulding, on the other hand, is dangerous, because the dural septa are overstretched and lacerated with trauma to one or more of the venous vessels coursing along their surface.

In mechanics, the effect of stress is strain. The stress on the foetal skull puts strain on the dural septa. The effect of stress varies and depends on where the stress is most. The most dangerous stress is produced when considerable reduction is brought about in the antero-posterior diameter of the vault with corresponding

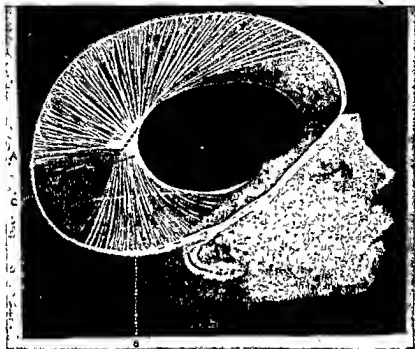


Fig. 136. Vertical section showing the dural septa.

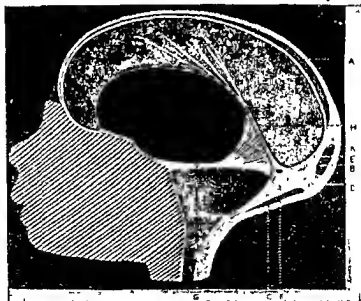


Fig. 137. Vertical section showing the position of the venous sinuses.

increase in the vertical height of the vault. The falx cerebri is a vertical system extending from the frontal to the occipital region. The posterior part of the inferior margin of the falx is firmly attached to the superior surface of the tentorium cerebelli where the straight sinus and the great vein of Galen are situated. Vertical overstretching of the dural region results in injury to these vessels. Three conditions produce marked reduction in the antero-posterior diameter of the vault: cephalopelvic disproportion, pelvic application of the obstetric forceps to a transversely arrested head, and after coming head of breech.

The tearing of the dural septa results in rupture of the big vessels or their tributaries. Haemorrhage may take place from the following sources:

(1) The vein of Galen, whose fixed point is at the apex of the tentorium cerebelli, is frequently distorted during moulding of the head and may rupture at the point where the straight sinus is formed. The collection of blood is subtentorial to the mesencephalon around the cerebellum, pons and medulla.

(2) Rupture of the tentorium with extension medially into the straight sinus, or laterally into the lateral sinus, with subtentorial haemorrhage.

(3) Cerebral veins near their terminations in the superior longitudinal sinus may be torn during parietal overlapping. The effused blood is subdural and is unilateral. Very rarely the superior longitudinal sinus itself is torn.

(4) Small tentorial vessels may be torn with supratentorial collection of blood.

Etiology. (1) *Prematurity.* Due to the softness and mobility of the cranial bones, and also because of the immaturity of vessel walls and a low prothrombin level, a premature foetus is more susceptible to both traumatic and anoxic types of haemorrhages. In more than half the cases of anoxic haemorrhage, premature deliveries are normal.

(2) *Excessive Moulding of Head.* Excessive moulding occurs in prolonged labours. The mechanical factors associated with the mode of delivery are principally responsible for intracranial haemorrhage. Owing to the greater use of caesarean sections during the last 20 years, the number of cases of difficult vaginal deliveries by internal version or difficult mid-cavity or high forceps, have been greatly reduced, with a corresponding reduction in the incidence of intracranial birth trauma.

It should be stressed that though the application of forceps may have been the ultimate mode of delivery, the cause of intracranial trauma in most of the cases is not due to the forceps, but due to excessive mouldings caused by a prolonged labour.

Occasionally, energetic measures undertaken to support the perineum may be so vigorous as to cause excessive compression of the occipital bone against the maternal pubic arch.

(3) *Rapid Moulding of Head.* Even a too rapid spontaneous delivery is likely to cause intracranial trauma. Rapid delivery of the after-coming head is an example of cranial stress, resulting in intracranial trauma.

(4) *Foetal Asphyxia.* Conditions causing intrapartum asphyxia have already been discussed, and asphyxia neonatorum is the continuation of the intrapartum anoxia.

(5) *Caesarean Section.* It is often stated that infants born by caesarean section are more liable to asphyxia neonatorum than those delivered vaginally. During vaginal delivery, aspiration of fluid in the upper respiratory passages or into the stomach is prevented by compression of the thorax and the abdomen by the maternal soft parts. There is a possibility of aspiration during a classical caesarean section, because the body is delivered first, and as there is no compressive action on the body, aspiration might occur before the head is delivered. In lower segment operation however, the head is delivered first, and the upper respiratory passages should be aspirated while the undelivered body is still compressed by the uterus.

Asphyxia Neonatorum due to Narcosis. Unless very large doses of narcotic drugs have been indiscriminately administered, the slightly depressed respiratory centre responds within a couple of minutes after birth, and the outlook is excellent. When profound depression of the respiratory centre is entirely due to the indiscriminate use of narcotics, the outlook is grave, and the infant fails to breathe and dies within a few minutes. The introduction of nalorphine to reverse the depressant action of morphia on the respiratory centre has changed the outlook in this type of asphyxia neonatorum.

Pulmonary Distress Syndrome

It is an inclusive term for the many causes resulting in the incomplete expansion of the lung or a portion of the lung. The causes of atelectasis fall into two groups, primary and secondary.

Primary Atelectasis. The important obstetric causes are prematurity and oversedation during labour. In premature infants, the incomplete expansion of lung is due to pulmonary immaturity, and also because of inadequate respiratory efforts of weak respiratory muscles.

When sedatives are given to the mother in too large quantities or too close to the time of delivery, the newborn remains in a state of apnoea for several minutes.

Secondary Atelectasis. The important obstetric causes are, massive inhalation of amniotic debris or mucus plugs, hyaline membrane formation and congenital anomalies in the respiratory system.

Massive Inhalation of Amniotic Debris. It is now established that many foetuses near term make respiratory-like movements in utero. Amniotic sac contents are found with such regularity in the lungs of stillborn and newborn infants that their presence must be considered a normal phenomenon. A second evidence is the presence in the lungs of the radioopaque dyes injected into the amniotic sac. Such physiological respiratory-like movements are shallow and intermittent.

Conditions tending to produce intrapartum foetal asphyxia cause the foetus to make deep respiratory-like movements, or to gasp in the uterus or the birth canal. Accidents responsible for intrapartum asphyxia have been previously discussed but, in general, they are placental insufficiency or compression of the umbilical cord.

Clinically, it is difficult to consider massive aspiration as the cause of asphyxia neonatorum, because cerebral injury which is associated with many of these cases is the chief cause of asphyxia pallida.

As a result of inhalation of infected liquor amnii either intra-uterine pneumonia or secondary postnatal pneumonia may develop. The amniotic fluid becomes contaminated when labour is prolonged after premature rupture of the membrane.

Pulmonary Hyaline Membrane Syndrome. There exists grave doubt whether the stainable membrane is the only cause of the symptoms. An apparently identical membrane is formed in the course of many other disorders.

Hyaline membrane is only found in live-born infants who have lived for more than one and a half hours. It is not found in still-born infants. The three conditions in which it is frequently found

are premature infants, infants born by caesarean section, and infants born of diabetic mothers.

The cause of the formation of a hyaline membrane is not known, though several theories have been advanced to explain the pathogenesis. One view is that the acidophilic squames in the inhaled liquor disperse round the walls of the alveoli in the form of a homogenous membrane. At the present time many consider that hyaline membrane is an incidental finding in cases of atelectasis.

Congenital Anomalies in Respiratory System. The congenital anomalies are pulmonary agenesis, congenital diaphragmatic hernia, and tracheo-oesophageal fistula.

Pulmonary agenesis may range from hypoplasia of one lobe to complete absence of both lungs. The effect of congenital diaphragmatic hernia depends on the volume of viscera herniated. Tracheo-oesophageal fistula does not cause immediate respiratory distress, but the effect is noticed after some hours.

Clinical Features

The most frequent sign of cranial stress is an abnormal colour of the newborn infant. According to the colour of the skin, it is customary to classify the cases into two groups: (1) *asphyxia livida*—blue asphyxia, and (2) *Asphyxia pallida*—white asphyxia.

Asphyxia livida is the milder variety and is characterised by the blue colour of the skin, most prominent on the lips and face, by a good general muscular tone, and by slow and forceful heart beats, frequently so forceful as to be seen at the apex. The eyelids are half open and the congested conjunctivae are visible. The cutaneous reflexes are present.

Asphyxia pallida indicates severe asphyxia. The infant is pale white in colour. The body and the limbs are toneless and limp. The heart beats are rapid and feeble.

Prognosis is related to the time taken for respirations to commence, and the type of respiration. When respirations are initiated within two minutes of birth, the prognosis is good, indicating that the medullary depression is reversible. Haller, Nesbitt and Anderson found that infants with anoxic intracranial haemorrhage initiated respirations more quickly than those with traumatic haemorrhage. Gibberd states that irreparable medullary depression is present when (1) over a period of five minutes the gasps come at prolonged intervals of 30 seconds or more, or when (2) in spite

of frequent gasps, the respirations remain shallow and irregular for more than ten minutes.

On examination, the fontanelles are bulging and tense, and the cry is feeble and shrill. In asphyxia pallida, the pupils are frequently unequal in size and may not react to light. The infants who begin to breathe and survive often succumb within the next four or five days. The infant is alternately quiet and restless, and resents handling by giving a sharp scream. Attacks of cyanosis is of poor prognosis. The swallowing reflex may be lost in some of the more severe cases, and careful nursing is important as the feeds may go into the larynx causing sudden cyanosis and death. Muscular twitchings are a grave sign, and are often followed by convulsions and death.

When the haemorrhage is diffuse, there may be no localising signs. In occasional cases, the site of localised haematoma can be diagnosed from nervous manifestations. When localised haematoma is supratentorial, the signs are cortical in nature. When the haemorrhage is infratentorial, bulbar signs are present.

It should be remembered that in the anoxic type of intraventricular or subarachnoid haemorrhage, respiratory distress syndrome is frequently associated in the form of atelectasis, massive pulmonary haemorrhage or pneumonia. The third to the fifth postnatal days are the most crucial, but death from pneumonia may occur at any time during the first ten days.

In cases which recover, paralysis is not usually noticed until several months have elapsed.

Treatment of Asphyxia Neonatorum

The era of treating asphyxia neonatorum by vigorous methods as cutaneous stimulation by vigorous rubbing and slapping, immersion alternately into warm and cold water, stimulation by drugs has passed.

The main principles of treatment of asphyxia neonatorum are: (1) position of the infant, (2) provide a patent airway, (3) administration of oxygen to overcome hypoxic apnoea, (4) stimulation by drugs, and (5) artificial respiration.

Position. After separating the infant, it should be kept in the head low position so that the drainage of the aspirated amniotic material is assisted by gravity. This is a simple but important, prophylaxis against the danger of the infant 'drowning' in its own

amniotic material. It is sometimes argued that the head-low position is liable to cause intracranial congestion and thus intracranial venous bleeding, but this appears to be more a theoretical consideration than an actually observed clinical fact.

Provisions for Maintaining a Patent Airway. Immediately after the birth of the head, the lumps of blood, mucus and meconium are removed from the mouth by gauze wrapped round the index finger. The finger should be passed as far back as possible along the dorsum of the tongue. After placing the infant in the head-low position, the material in the region of the epiglottis is aspirated by passing a small catheter and applying gentle suction. Occasionally, the airway is obstructed at a lower level, and it is necessary to pass an infant laryngoscope and aspirate the material under direct vision.

Administration of Oxygen. The most important means of resuscitation is administration of oxygen. Several modes of giving oxygen have been advocated. Ordinarily, oxygen is given by passing a small catheter into the nostril; oxygen is administered at the rate of one litre per minute. It may also be given by special baby face mask.

Intra-tracheal insufflation is advocated, but it can only be practised in a hospital by an anaesthetist or some one used to passing an endotracheal catheter. The catheter is attached to a rubber tube and oxygen is fed from a bag which acts as reservoir. The pressure in the bronchi does not rise above 10 cm. of water because there is free escape of oxygen between the catheter and the glottis. With this low pressure, there is no danger of rupturing the lungs. The advantages claimed for this method are that a free flow of oxygen is ensured, and even if the alveoli do not open, some oxygen passes into the circulation through the bronchial mucous membrane.

Intra-gastric oxygen is advocated as a safe and effective procedure providing a large gastric and intestinal mucous surface from where oxygen can pass into the circulation. Two fine rubber catheters are passed into the stomach to a length of 17 cm. from the alveolar margin. One of the catheters acts as an outlet tube, the outer end of which is placed under water to ensure that oxygen escapes through it. The gas is passed at the rate of $\frac{1}{2}$ to 1 litre per minute.

Stimulation by Drugs. Stimulant drugs, such as alpha-lobeline and nikethamide, were routinely used in the past, but they are

no longer used. The doses in which they were previously employed are ineffective, and large doses tend to produce convulsions.

When foetal anoxia is attributable to morphine, pethidine or dilaudid, nalorphine (Lethidrone, Burrough Wellcome) is used to reverse the respiratory depressant action of the above drugs. This drug is closely related to morphine chemically, but, pharmacologically, it is a specific antagonist to morphine and its derivatives. It is injected into the umbilical vein, the dose being 0.25 mg.

Management of Infants Who Recover from Initial Anoxia. These infants are kept in a quiet, darkened room. Magnesium sulphate, $\frac{1}{2}$ c.c. 25%, is injected intramuscularly every 8 hours for one day. Vitamin K, 5 mg., is injected as a precaution against further venous oozing. If the child is restless and has a distressed shrill cry, it is kept sedated by giving Luminal orally or, in more severe cases, by injection. Careful sedation reduces the risk of muscular spasms and convulsions. Penicillin 50,000 units are injected twice a day for the first 2-3 days to prevent infection. Feeding should be done more carefully, and if the swallowing reflex is absent, it is better not to give oral feeds.

Artificial Respiration. In the past, artificial respiration, by vigorous shock producing methods, was routinely practised, but at the present time they are of academic interest only. As a matter of interest the reader is advised to go through text books of obstetrics written thirty years back. At the present time, the only permissible method of artificial respiration is gentle compression of the thorax every few seconds.

Other Birth Injuries

In general, birth injury indicates the damage which may occur to the foetus between the onset of labour and the establishment of independent extra-uterine life. Birth injuries include, beside actual rupture of tissues, also the harmful effects of pressure or inadequate supply of oxygen to the foetus. For clinical purposes, birth injuries are conveniently grouped into:

(1) Intracranial injuries (described under asphyxia neonatorum).

(2) Cranial and peripheral injuries.

Cranial Injuries

Cephalhaematoma. It is a slow accumulation of blood between the bone and its periosteum. The haematoma is sharply delimited

by the adherence of periosteum to the margins of that particular bone at the suture line. In most cases, one parietal bone is affected, and only occasionally it lies over the frontal or the occipital bone. It is usually stated that the underlying bone is intact but Kendall and Woloshin, by taking x-ray films in three views, found linear fractures in 25 per cent of their cases.

The predisposing obstetrical causes are, cephalopelvic disproportion, forceps delivery or the after-coming head of breech. It may appear at birth or develop gradually during the first three days. It may increase in size during the first week. A few days after its formation, a hard ring is felt round the edge in marked contrast to the soft centre which is likely to be mistaken for a fracture. There is never any difficulty in diagnosing a parietal cephalhaematoma because of its typical shape and situation. Because of the midline position of an occipital haematoma and an occipital meningocele, the two sometimes cause difficulty in diagnosis. The absence of an impulse, negative skull x-rays, decrease in size during the next few weeks and beginning calcification in a few weeks are useful points in the diagnosis of cephalhaematoma.

A great majority of cephalhaematoma get absorbed within a few weeks and no treatment is necessary. A few get calcified and persist for a long time as unsightly bony knobs. A large cephalhaematoma may be aspirated under proper asepsis. Very rarely, a cephalhaematoma may suppurate and require incision and drainage.

Depression of Cranial Bones with or without Fracture. The usual causes of this injury are pressure of the tip of an improperly applied forceps indenting the bone, or the pressure of a forward projecting promontory on the posterior parietal bone. The fracture caused by the tip of the blade of a forceps is gutter-shaped, while that due to pressure of the promontory is spoon-shaped. By x-ray examination, the fracture can be visualised as inward concavity with or without a visible fracture at the depth of the concavity.

The depression often corrects itself spontaneously. The present trend is to surgically correct every case irrespective of whether it is showing signs of localised intracranial pressure.

Peripheral Injuries

Facial Nerve Paralysis. Peripheral facial nerve palsy sometimes occurs by pressure of the blade of the forceps on the facial

nerve at its exit from the cranium, but it also occurs after spontaneous vaginal deliveries. Very rarely, injury to the intracranial part of the nerve is caused by intracranial haemorrhage.

The characteristics of the peripheral nerve injury are, the half open eye on the affected side, the side of the face appears smooth with drooping of the corner of the mouth, and obliteration of the nasolabial fold.

The peripheral traumatic nerve injury cases invariably recover within a few days or in a few weeks.

Brachial Plexus Injuries. Injury to the fifth or sixth cervical roots is known as Erb's paralysis. Injury to the eighth cervical and the first dorsal nerve roots is known as Klumke's palsy. Erb's palsy is the commoner of the two. Overstretching of the nerve roots in cephalic presentations results when difficulty is encountered in the delivery of the shoulders. A similar effect may be produced during delivery of the after-coming head.

The disability in Erb's palsy is immediately noticeable at birth. As a result of the paralysis of the deltoid, and the infraspinatus and flexor muscles of the forearm, the entire arm internally rotated falls close to the side of the body. The arm is held straight at the elbow with the forearm pronated.

In the rarer Klumke's palsy, the disability is limited to the wrist and hand. The grasp reflex is abolished and the hand is held limply flexed.

Treatment. To protect the paralysed muscles in Erb's palsy from over-action of the unopposed antagonists, the arm is tied to the head of the bed in such a way that it is held abducted, externally rotated and supinated. To get the best results, the infant should be put under the care of a competent orthopaedic surgeon.

Fracture of Clavicle. Clavicle is likely to be fractured when difficulty is encountered in the delivery of the shoulders in vertex presentation. The treatment of fractured clavicle consists in placing a soft pad in the axilla and bandaging the upper arm to the chest.

Fracture of Humerus. The humerus is usually fractured in the upper half during delivery of an extended arm in a breech presentation. It is caused when the accoucheur attempts to flex the extended arm by pressure on the humerus. The management of fractured humerus is by maintaining the arm in "hand on hip" position.

Fracture of Femur. It is caused during faulty manipulation for bringing down an extended leg. It is treated by vertical extension, the baby's ankles being fastened to a cross bar above the cot.

Trauma to Soft Parts. Injury to the sterno-mastoid muscle is likely to occur during breech delivery. The muscle may be torn or its fascial sheet causing formation of a haematoma with gradual cicatricial contraction. In most cases, the swelling disappears spontaneously, but in a few cases torticollis results.

The liver or the spleen in the new born are injured during breech delivery by faulty holding of the foetus. Haemorrhage beneath the capsule or into the peritoneal cavity results.

SECTION XI

NORMAL AND ABNORMAL PUERPERIUM

CHAPTER 1

NORMAL PUERPERIUM

The puerperium commences after delivery of the placenta and the membranes and is completed after six weeks, although the most rapid changes occur within the first two weeks. It is a period during which the maternal organs return to normal; reversion of metabolic changes of pregnancy occurs and lactation is established. The retrogressive changes in the genital organs are called involution.

Changes In Genital Organs

(1) **Changes in Uterus.** Immediately after delivery, the size of the uterus is about 15 cm. long, 12 cm. broad, and 4-5 cm. thick in the upper segment and 1 cm. in the lower segment. It weighs about 1,000 gm. (2.2 lbs.). The maximum involution of the uterus occurs during the first week by the end of which it weighs about 500 gm. By the end of the second week it weighs about 350 gm. and then the size and the weight gradually reduce till it weighs 60 gm. by the end of the sixth week.

Immediately after delivery, the height of the uterus is upto or just below the umbilicus. By the end of the first week it is about three fingers breadth above the pubes and by the 12th to 14th day it sinks below the pelvic brim and is not palpable per abdomen. The average height of the fundus is about 14-15 cm. (5½-6 ins.) on the first day, by the end of the first week it is about 7-8 cm., and by the twelfth day 2 cm. above the symphysis pubis. A full bladder raises the uterus upwards and therefore the size should be measured after emptying the bladder.

The serous coat of the uterus wrinkles during the first week due to rapid reduction in the size of the uterus. This reduction in size is chiefly due to the changes in the muscular wall of the uterus. The muscular fibres diminish at a uniform rate and by the end of

the sixth week they are actually shorter than in the non-pregnant organ. It has been estimated that individual cells decrease in length from 208.7 to 24.4 microns during the process of involution. This reduction is effected by autolysis of the muscle fibres. The protoplasm is broken down by proteolytic ferments. The clinical evidences of autolysis are the great increase in the total quantity of nitrogen in urine during the first few days of puerperium and the presence of peptone in the urine of puerperal women.

The changes in the endometrium are the most important. Most of the decidua comes away with the placenta and membranes, and a raw area is left all over the cavity. The placental site measures about 7.5 cm. in diameter on the first day and is recognised by its elevated surface. The surface of the entire cavity is rough due to the presence of shreds of the decidua and bits of membranes. Regeneration takes place from the remaining deeper portion of decidua basalis. The epithelium from the open lumina of the stumps of glands proliferates rapidly and grows all over the surface of the endometrium so that the uterine cavity is covered by a fresh mucous membrane by the end of the first week. The blood vessels in the endometrium get thrombosed and some of the blood vessels are permanently obliterated by organisation of the thrombus. The site of the obliterated blood vessels is marked by a ring of elastic tissue and provides an evidence of previous pregnancy. Some thrombosed vessels are recanalised and are replaced by smaller ones.

(2) **Changes in Cervix.** Immediately after delivery, the cervix is soft, bruised and oedematous. It hangs loose in the vagina. Within two days the cervix regains its form, shortens and becomes firm. Up to ten days, two fingers can be passed into the cervical canal, but by the end of the second week one finger only is admitted.

(3) **Changes in Vagina and Vulva.** Immediately after delivery, the vagina is capacious, swollen and bruised. The vaginal walls remain vascular and friable for several weeks and therefore any operative procedure during this time is likely to cause considerable oozing; stitches have a tendency to cut through. The vaginal rugae reappear after about three weeks.

The pelvic muscles appear toneless due to overstretching and oedema. In four to six weeks, the muscular tone returns.

The hymen is bruised and the hymenial tags become fibrous and are known as carunculae myrtiformes.

The vulva gapes for two or three weeks after delivery but, as

muscular tone is regained, all that is seen at the end of six weeks is separated labia minora.

(4) *Lochia*. The discharge from the genital canal during the first four weeks after delivery is called lochia. For the first two days it is fluid and bright red in colour. From the third day the colour becomes fainter and, after a fortnight, it becomes whitish. *Lochia* is thin at first, later becoming sticky due to increased amount of mucus. The lochia becomes foetid from decomposition of retained fragments of chorion. In many cases the offensive odour is merely due to accumulation of lochia in the uterus or in the posterior vaginal fornix.

The lochia is alkaline while in the uterus, but becomes acid in the vagina. At first, it consists of blood and tiny fragments of mucus, decidua, peptones and cholestrin crystals. Later on, there is addition of leucocytes. The quantity of lochia varies. It is profuse for the first few days but may stop almost entirely and restart after an interval. It may become red again and persist as a red discharge for several weeks.

Breasts. Unless the breasts have been activated by oestrogens and progesterone during pregnancy, the prolactin (a hormone of anterior pituitary) is unable to stimulate the secretion of milk. During pregnancy, oestrogens proliferate the duct system and progesterone the alveolar system of the mammary glands.

For the first two or three days the thick yellowish discharge, called the *colostrum*, is secreted by the breasts. Colostrum consists of fat globules and colostrum corpuscles. The latter are stellate cells containing fine fat globules, sometimes showing amoeboid movements. These cells are altered cells of glandular epithelium or leucocytes and have fat globules within them.

The secretion of milk commences on the third day. The breasts become hard and bluish veins are visible over the shiny skin. The congestion of the breasts is much more in primiparae than in multiparae. The secretion of milk occurs earlier in multiparae, even as early as on the second day. The turgescence is greater when the ducts are blocked by the thick colostrum and it is therefore necessary to squeeze the colostrum out on the second and the third days to maintain the patency of ducts for the easy flow of the milk.

Reversion Of Metabolic Changes

Water and Salt Metabolism. There is a tendency for retention of water and salt in the tissues during the later months of preg-

nancy, and this accumulated water is excreted in urine during the first few days of puerperium. As a result, the oedema of feet, commonly present in pregnancy, disappears. The marked oedema of feet and of other parts of the body in toxæmic patients takes longer to disappear.

Blood. The increased blood volume during pregnancy, particularly the plasma volume, returns to the pre-pregnancy level within a week of the delivery. Due to the reduction in plasma volume, the haemoglobin level rises and reaches its normal level by the fifth day. There is a sudden increase in platelet count during the first ten days. There is considerable rise in leucocyte count, 12,000 to 15,000, immediately after delivery which returns to normal within a few days after delivery.

Urine. Lactose appears in the urine with the commencement of lactation. There is an increased output of urinary nitrogen, part of which is due to the breakdown of the uterine muscles. In many cases, traces of albumen, due to excretion of peptones, are found for the first few days of puerperium.

Skin. The pigmentation of the skin in different parts of the body disappears gradually.

Management Of Puerperium

Even cases of normal delivery should not be shifted from the labour room to the ward for at least two hours after the completion of the third stage. It is necessary to watch the patient during this period for there is a risk of her going into a state of shock from external bleeding or from collection of blood in the cavity of an atonic uterus.

During these two hours, half-hourly pulse record is kept and the amount of bleeding at the perineum is frequently observed. If an abdominal binder has been applied, it should be opened after one hour and the size, the position and the tone of the uterus noted. Frequently, the uterus contains a few clots which are gently expressed. Occasionally, though there is no external bleeding, a large quantity of blood collects in an atonic uterus which progressively increases in size. The patient complains of abdominal pain when blood clots distend a well-retracted uterus, but large quantity of blood can collect in an atonic uterus without much discomfort.

Pulse. After a normal delivery, the pulse rate usually slows down and, frequently, the rate is as slow as 60 per minute. The

normal rate is restored in 24 to 48 hours. A rapid pulse is due to ante or post partum haemorrhage, a prolonged labour, anaemia, cardiac disease or anaesthesia.

Temperature. It is not unusual for temperature to rise upto 100°F. soon after delivery. This rise returns to normal within 24 hours. Rise of temperature usually occurs in a prolonged labour, but may also occur when labour has not been prolonged. It is indicative of severe muscular fatigue during labour. Any rise of temperature after 24 hours should be considered as abnormal.

Urine. Many women find difficulty in passing urine for the first few days. Bruising of the external genitalia during labour, perineal stitches, lax abdominal wall and the recumbent position are the causes for retention. Catheterisation should be withheld as much as possible for fear of urinary tract infection. Instead, the patient should be encouraged to try and pass urine on a commode placed by the side of the bed. Tablets or injections of Carbachol should be given a trial. As a rule, the difficulty in passing urine is relieved within a week. Should catheterisation be necessary, a properly sterilized rubber catheter is used. After cleaning the vulva, the urinary meatus must be first located and the tip of the catheter is passed straight into the meatus without touching the surrounding parts. The chances of infection are not so much from the use of a catheter as from the tip of the catheter coming in contact with surrounding areas before it is passed into the urethra. When repeated catheterisation is necessary, it is better to put in an indwelling catheter for two or three days.

Sometimes, small quantities of urine are passed at frequent intervals and this is a sign of retention of urine with overflow and, when these patients are catheterised, large quantity of residual urine is drained out. If this repeats, an indwelling catheter should be kept for a few days until the bladder tone is restored.

It is not uncommon for patients to develop stress incontinence due to overstretching of the structures in the region of the trigone and the urethra. Therefore, as a prophylaxis, all patients should be advised perineal exercises during the puerperium.

Apart from infection resulting from repeated catheterisation, urinary infection otherwise also occurs. It is discussed later under "Abnormal Puerperium".

Bowels. As an enema is usually given at the commencement of labour, bowel movement does not occur on the first day after the delivery. Each clinic has its own routine. Our routine is to

give one ounce of milk of magnesia on the second night followed by a simple enema on the following morning. Thereafter, one ounce of milk of magnesia is given every night for the next few nights to ensure daily bowel action. Due to lack of tone of abdominal muscles, gaseous distension and constipation are common complaints for a few weeks after delivery.

Diet. After a normal delivery, full wholesome diet can be given even from the first day. Many, however, do not feel inclined to take solid food for the first two or three days. A liberal quantity of milk must be given.

Sleep. Frequently, due to emotional excitement of childbirth, patients do not get natural sleep on the first day and need some hypnotic to induce sleep. Sleeplessness during the early days of puerperium without any obvious reason is a sign of impending puerperal psychosis. Therefore, sleeplessness should not be allowed to continue and proper doses of hypnotics by mouth or even by injections must be prescribed.

Early Ambulation. Formerly, patients were not allowed even to sit up in bed before perineal stitches were removed. That was necessary because then perineal tears were sutured in one layer which included the posterior vaginal wall, the perineal muscles and the skin. With such a routine, thrombosis of the veins of the lower limbs due to venous stasis frequently occurred. The present day method of suturing in layers renders enforced rest in bed unnecessary and patients are allowed to get out of bed even on the second day. This early ambulation has several advantages. Drainage from the vagina is better, and there is less tendency to retention of urine and constipation. As a result of normal venous return from the lower limbs, thrombophlebitis has become rare. Lastly, nursing duties are simplified as few patients require to be given bed pans and the mothers can look after the babies with less assistance from the nurses. Besides, there is a psychological advantage in the fact that the parturient does not consider herself to be a patient.

Care of Episiotomy. Asepsis should be maintained by covering the perineum with sterile gauze. After passing urine and evacuation of bowel, the perineum should be washed with an antiseptic lotion and dusted with sulphonamide powder. Swabbing of the vulva is always carried out from above downward to avoid contamination from the anus. Atleast once a day spirit should be applied to the suture line. The stitches are removed on the sixth day. The wound should be examined each day for oedema and

redness along the suture line. There may not be any rise of temperature for several days and yet the wound may be inflamed. If any signs of inflammation appear, the stitches should be removed immediately and hot fomentation applied twice a day.

Lochia The amount and appearance of lochial discharge should be observed daily for the first ten days. An offensive lochia suggests infection of genital tract, but it may be just due to stasis in the vagina when patient is kept in a recumbent position for several days. Whenever tears in the vaginal wall or cervix have been sutured, it is advisable to instil two ounces of glycerine acriflavin or glycerine mercurochrome daily in the vagina. Suppression of lochia indicates either severe sepsis or blockage of the cervical canal.

Height of Fundus. The rate of involution of the uterus is observed daily by measurements of the height of the fundus above the symphysis. It should be done at about the same time each day and always after emptying the bladder, as a full bladder raises the fundus to a higher level. Normally, the uterus should sink below the pelvic brim by the 12th to the 14th day. Subinvolution may be due to uterine infection from retained products of conception, fibromyomata, or lack of breast feeding due to a stillbirth or due to depressed or cracked nipples.

Abdominal Binder. An abdominal binder is necessary for the first 12 hours after delivery to control the fundus from rising as a result of collection of blood in its cavity. Before tying the binder, the uterus should be massaged and blood clots collected in the cavity are expressed by gentle pressure on the fundus. After the first 12 hours, an abdominal binder is not necessary and in most clinics it is discarded. Many women prefer to keep the binder for a few days as it gives support to the lax abdominal wall. The binder should extend from above the level of the umbilicus as far down as the greater trochanter.

After Pains. Most multiparae complain of after pains for the first few days. After pains are the painful contractions of the uterus. The pain is continuous and is more severe during breast feeding. It needs to be relieved by analgesic tablets. Slight pains are necessary to maintain retraction of the uterine musculature. Even tiny clots give rise to severe after pain and their expulsion gives immediate relief.

A full bladder is a common cause of lower abdominal discomfort during the early days of puerperium, specially in primigravi-

dae with bruising of the vulva and perineal stitches. If retention is suspected, catheterisation relieves the pain.

Management of Newborn Infant

Immediate Care. As soon as the head is born, the eyes and the nose of the child are wiped with small swabs and the throat is cleared. If the cord encircles the neck, it is pulled over the occiput or, if there is more than one loop, the cord is clamped in two places and is cut. External rotation occurs immediately so that the face turns laterally, but if there is any delay it should be rotated manually and thus the mouth is protected from the gush of hind waters. This deliberate waiting for a short while before allowing the rest of the body to be born not only gives time for the uterus to retract and thus reduce the blood loss but also brings about a compression of the chest by pressure on the undelivered trunk and thereby prevents further inhalation of liquor and expels the secretions that may have been already inhaled.

Immediately after the birth of the child, it is held up by its feet so as to allow the swallowed secretions to flow out and thus prevent its inhalation into the air passages. The throat is cleared by mild suction or pieces of gauze wrapped round the little finger.

After a normal delivery, the child cries lustily immediately but, when labour has been prolonged or anaesthesia has been given, it does not cry for several minutes. If respirations have commenced and the child is not cyanosed, no further measures are necessary.

In cases of prolonged labour with moulding and formation of caput, the baby is frequently cyanosed, and it is advisable to give oxygen for some time. The gas should be passed through water as it is then less irritating to the infant's mucous membranes.

The cord should be divided when it has stopped pulsating. It is advisable to wait for a short time before clamping the cord to allow as much blood as possible from the placenta to enter the foetal circulation. In cases of Rh blood incompatibility, the cord is clamped immediately at birth before it has stopped pulsating. The cord should be clamped at two places. The first clamp is applied at least 4 inches away from the navel, and the cord is cut in between the clamps. In twin delivery, it is essential to ligate the cord of the first twin at two places before being cut to prevent blood loss from the second twin. In Rh negative cases, ten c.c. of blood is collected in a sterile test tube and allowed to clot. It is meant for

estimating the serum bilirubin, for blood grouping and for Coomb's test. Two c.c. of blood in oxalate for Rh grouping, and 2 c.c. in citrate solution for cross matching with the serum of donor are also collected. In these cases, the foetal end of the cord should be kept particularly long so that a good length is available for passing a polyethylene tube for replacement transfusion.

Careful antiseptic precautions are required for ligaturing the cord. Two ligatures of twisted thread, previously autoclaved, should be applied at $2\frac{1}{2}$ inches from the umbilicus. The cut end of the cord is inspected to ensure complete haemostasis. Iodine is applied and the cord is wrapped in a sterile gauze piece. The child is then wrapped up in a warm blanket. It is placed on its side in an inclined position with the head lower than the rest of the body.

The infant is next examined for any visible deformities and congenital defects such as cleft palate (which would hinder sucking), hernia or undescended testicles. If there has been meconium stained liquor or meconium is passed at birth, the question of imperforated anus does not arise but in all other cases little finger is passed in the anal canal to exclude this condition. Urine may be passed at birth or soon after, but in many cases urine is not passed for as long as twelve or more hours after birth. If urine is not passed for 24 hours, a tiny rubber catheter should be passed to relieve the bladder and at the same time to exclude malformation of the urethra.

Care of Eyes. The former Crede's method of instilling a drop of 1 per cent silver nitrate solution into the eyes of the newborn is still practised in hospital cases but in other cases, apart from cleaning the eyes with normal saline, silver nitrate instillation is not done. If during the first few days purulent discharge occurs, a Gram-stained smear of the pus should be examined for responsible organisms and the appropriate treatment given.

All vernix and adherent blood clots are removed by the use of warm olive oil. Unless all the vernix is cleaned from folds of the skin of groin and axilla, cutaneous irritation is likely to occur. Baby is then bathed with soap and warm water. Umbilical cord is preferably not soaked whilst giving the bath. It should be carefully dried by sterile gauze and then dusted with sulphonamide powder. It is then wrapped up in a piece of dry gauze and an abdominal binder is applied. The umbilical cord usually undergoes a dry aseptic necrosis and separates spontaneously within a week leaving a small clean ulcer which cicatrises rapidly. In some cases

the root of the cord undergoes a moist form of necrosis without any offensive odour, and separation is delayed as long as 15-20 days. In such cases, it is necessary to apply spirit at least twice a day and scrupulous aseptic care is necessary to prevent infection.

CHAPTER 2

ABNORMAL PUERPERIUM

PUERPERAL SEPSIS

Definition. Puerperal sepsis is a wound infection like the infection of a raw surface in any other part of the body. A rise of temperature above 100°F. after the first 24 hours and either maintained for 24 hours or occurring on more than one occasion needs investigation for its cause.

Etiology

Predisposing Factors. There are certain predisposing factors which make a parturient woman more prone to genital infection.

(1) *Presence of Open Wounds and Raw Surfaces.* Every parturient woman has a large raw area in the uterine cavity where the placenta was attached. In addition, there is some amount of bruising and laceration of the cervix, the vagina and the perineum. Therefore, a woman after childbirth runs the potential risk of infection at any of these sites.

(2) *Lowering of General Resistance.* The ability to overcome infection depends largely on the general resistance of the patient. Debilitating conditions, such as anaemia, malnutrition, toxæmia and ante-partum or post-partum hæmorrhage, predispose to infection.

(3) *Early Rupture of Membranes.* The incidence of puerperal infection is related to some extent on the interval between the rupture of the membranes and completion of labour. When labour does not commence for several days after premature rupture of the membranes, there is likelihood of intrauterine infection, maternal as well as foetal.

(4) *Duration of Labour.* Exhaustion, as a result of prolonged labour, predisposes to infection. Factors contributing towards devitalization are: dehydration and acidosis, lack of adequate sedation, and undue prolongation of labour.

(5) *Intrauterine Manipulations.* Malpresentations, prolapse of the foetal limbs or umbilical cord require intrauterine manipulations and that too usually after a prolonged labour. The patient

is predisposed to uterine infection in these conditions from organisms already present in the lower genital tract or transferred from some outward source.

During manual removal of the placenta, the hand comes in direct contact with the placental sinuses and there is a grave risk of puerperal infection.

(6) *Low Implantation of Placenta.* The raw placental area in the lower segment close to the vagina is theoretically more prone to get infected, but in practice the incidence does not appear to be higher than in cases of implantation in the upper segment unless some operative manipulations are needed to stop the bleeding.

Causative Organisms. *Streptococcus Haemolyticus.* Haemolytic streptococcus is the commonest organism responsible for puerperal infection. Many groups of streptococci have been isolated but the virulent strain, *Streptococcus Haemolyticus* Group A (*Streptococcus pyogenes*), is the organism responsible for almost all cases of severe puerperal infection. Unlike some other strains of streptococci, it is not normally present in the vagina and therefore infection by *Streptococcus Haemolyticus* Group A is always from an outside source. Common sources of infection are the nose or the throat of the attendant or lack of asepsis during labour.

Before the introduction of sulphonamides and antibiotics, streptococcus haemolyticus was responsible for most of the fatal cases of puerperal genital infection but nowadays chemotherapeutic drugs readily control the infection.

Anaerobic Streptococcus. It is present in the vagina in 1 to 2 per cent of women as a non-pathogenic organism. It becomes pathogenic during the puerperium in the presence of necrotic or sloughing pieces of placenta or membranes retained in the uterine cavity or when there are sloughing vaginal or cervical lacerations.

Staphylococcus. It is a rare cause of uterine sepsis. It is a frequent cause of local perineal skin infection. Systemic infection by staphylococcus aureus is of a virulent nature and the gravity is further increased by its being resistant to most of the antibiotics.

B. Coli. Owing to the close proximity of the vagina to the rectum, it would appear to be a frequent microbe causing puerperal sepsis but that is not so in clinical practice. It is normally present in the vagina of some women. When it does become pathogenic, it causes localised uterine infection.

Clostridium Welchii. It is present as non-pathogenic organism in the vagina of 1 to 2 per cent of women and may become viru-

lent from this source, but in the majority of cases, *Cl. Welchii* gains entry into the genital canal from an exogenous source. Clinical manifestations and treatment are described under septic abortion.

B. Tetanus. It is always introduced from an outside source. Genital infection by *B. Tetanus* is not rare in India and is described separately.

Mode of Entry of Organisms. There are three sources from where organisms can gain entry into the genital canal. They are *endogenous*, *autogenous* and *exogenous*.

Endogenous Infection. It is caused from organisms already present in the vagina. Such organisms are *Streptococcus anaerobicus*, *B. Coli* and *Cl. Welchii*. These organisms more often become pathogenic in the presence of sloughing tissues.

Autogenous Infection. Infection is caused by organisms present in some other part of the body, which secondarily infect the genital canal. Autogenous infection is uncommon and may occur by blood stream spread from distant foci such as an infected throat. It may also occur by the direct contact of the genitals by the fingers of the patient who has a *whitlow* or some other staphylococcal skin lesion. *B. Coli* and anaerobic bacteria from the anal canal are also sources of autogenous infection.

Exogenous Infection. It is caused by organisms from an outside source gaining entry into the genital canal. This is the most common and the most important mode of entry. Infection caused by *Streptococcus haemolyticus* is always of exogenous origin. Haemolytic streptococci are not normally present in the human vagina as they cannot survive in the acid vaginal secretions. The common outside source is direct droplet infection from the nose or the throat of the attendant. This has been proved by finding the same strains of streptococci from the genital tract of the patient and from the throat culture of the attendant.

Another exogenous source is a vaginal examination during labour without proper asepsis. It is, therefore, necessary to wear sterile gloves and observe strict asepsis for vaginal examination during labour. Operative manipulation is yet another source of implanting these virulent organisms, particularly during manual removal of the placenta.

Clinical Varieties of Puerperal Infection

(1) **Localised Wound Infection.** Local infection of perineal, vaginal or cervical lacerations during puerperium is not uncommon.

Placental site remains as a raw area for several days after delivery and is a potential source of localised uterine sepsis in every recently delivered woman. Local infection of abdominal incision after caesarean section is also a source of localised infection.

(a) *Perineal Infection.* It is at the site of the sutured episiotomy or perineal lacerations. The infected area becomes red, oedematous and tender, with rise of temperature usually not more than 101°F . In some cases even small collection of pus under tension gives rise to temperatures of 103° - 104°F . with rigors. The temperature falls rapidly when tension is relieved by cutting the sutures and allowing free drainage.

Another source of infection is a "hidden tear of the perineum". Here the site of infection is the superficial perineal haematoma.

(b) *Vaginal and/or Cervical Lacerations.* Sometimes, an undetected tear in the upper part of the vagina or in the cervix gets infected giving rise to mild sepsis with purulent foul-smelling discharge. Formerly, such an infected wound frequently spread, either by direct extension or by lymphatics, to the pelvic cellular tissues but with the routine use of antibiotics, pelvic infection is rare.

Infection of Uterus. The site of infection is the raw placental area. The infection in many cases is mild but a severe form of uterine infection is met with in some of the cases.

Mild Infection. In mild infection the common causative organisms are anaerobic streptococci or *B. Coli*. A common predisposing cause of mild uterine infection is retained products of conception in which the organisms get a very favourable nidus for growth. In mild infection, a massive zone of leucocytes forms in the deeper parts of the endometrium and in the myometrium. As a result, the infection does not spread beyond the deeper part of the myometrium. Infection of the sloughing necrotic tissues produces large quantities of foul-smelling purulent lochia.

The usual time of onset is on the third or the fourth day of puerperium. There is rise of temperature which is seldom higher than 100° - 102°F . In contrast to severe infection, the fever is not accompanied by rigor though the patient may have slight chilly feeling. The pulse rise is proportionate to the temperature and ranges between 100-120 per minute. A mild degree of toxicity is evident as general malaise, loss of appetite and frontal headache. There is mild leucocytosis of 12,000 to 15,000 per c.mm. The temperature gradually becomes lower and by the end of the first week becomes normal (Fig. 138).

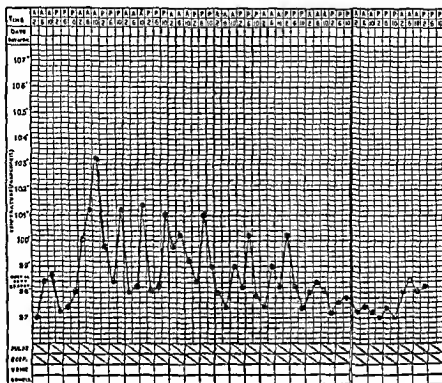


Fig. 138. Temperature chart of mild uterine infection.

On examination, the uterus remains unduly large and may be felt at the level of the umbilicus towards the end of the first week. It is not as hard as a normal involuting uterus and is tender to touch.

The diagnosis is evident from the above clinical features but a speculum examination is advisable to exclude infected vaginal or cervical lacerations as the cause of foetid lochia. This should never be neglected if the delivery has been instrumental, or when vaginal or cervical lacerations have been sutured.

Acute Pyometra. Occasionally, purulent foetid lochia is retained in the uterine cavity by occlusion of the cervix. The uterus is then distended to any level in the abdomen and, remaining undiagnosed, may rise almost to the costal margins. The consistency of the uterus is soft and it is tender on palpation. The clinical features are as described above. On passing a cervical dilator into the uterine cavity, large quantities of foetid lochia drain out. The clinical condition of the patient improves soon after proper drainage has been established. Acute pyometra is uncommon and is observed

more frequently as a complication of infected abortion than after childbirth.

Severe Infection. The symptoms and physical signs are similar in most respects as in mild infection but of greater severity. The causal organism is almost always streptococcus haemolyticus. The temperature rises to 103°-104°F. and is often accompanied by a chilly feeling or a proper rigor. The patient is more toxic. The pulse rate is usually as high as 120-130 per minute. The lochial discharge is profuse in some cases while scanty in others, or it may be temporarily arrested. It is not offensive unless there are necrotic retained products of conception in the uterine cavity. The leucocyte count rises up to 20,000 per c.mm. When a repeat count shows an increase in the number, spread of infection beyond the uterus is to be suspected.

Spread of Localised Genital Infection. The pelvic tissue gets infected either from a sloughing wound of the cervix or from the localised infection at the placental site. The infection may be due to a direct spread along the cellular planes from the cervix or extension may take place along the lymphatics of the cervix or the body of the uterus. Thrombophlebitis of the pelvic veins results from spread of infection from the veins in the uterine wall.

The infection may become generalised when the organisms grow in the blood stream giving rise to septicaemia.

Local Pelvic Infection. Irrespective of the mode of spread along cellular planes, along lymphatics or along venous channels, the inflammatory process involves all the structures in the pelvic cavity to a greater or lesser extent. When the infection is predominantly in the pelvic cellular tissue, it is termed pelvic cellulitis; when the adnexae are chiefly involved, it is called salpingo-oophoritis; and it is termed thrombophlebitis when the infection is severe in the veins of the pelvic cavity.

Pelvic Cellulitis. The onset of pelvic cellulitis is usually towards the end of the first week. A patient who has been running a low grade temperature during the first week, suddenly has a sharp rise of temperature accompanied with rigors and acute pain, tenderness and rigidity in the lower abdomen (Fig. 139).

On vaginal examination, an indurated, ill-defined swelling is palpated on one side of the uterus, which might later extend to the other side and to the pouch of Douglas. On speculum examination, an infected laceration of the upper part of vagina or of the cervix will be found.

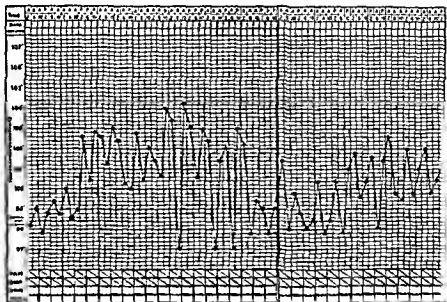


Fig. 139. Temperature chart of pelvic cellulitis.

Usually, the infection subsides, without any suppuration, in the course of one or two weeks. But, when the temperature, pain and tenderness persist, suppuration is to be suspected. It takes about four to six weeks for a pelvic abscess to develop. The induration spreads further and may rise into the abdomen as high as the umbilicus or may spread downwards to form a pelvic abscess. With the formation of a pelvic abscess, rectal tenesmus develops in some cases and retention of urine is a prominent symptom. The abscess may point towards the posterior fornix or in the abdomen above the Poupart's ligament.

Salpingo-oophoritis and Pelvic Peritonitis. It results from the spread of infection from the lymphatics of the uterus. Direct extension from the endometrium to the epithelium of the tubes rarely occurs. The pelvic peritoneum is involved to some extent and adhesions form between the adnexae and the surrounding structures.

The clinical course is more or less as described for cellulitis. Suppuration gives rise to an acute pyosalpinx or an intra-peritoneal pelvic abscess which points in the posterior fornix.

Pelvic Thrombophlebitis. The infection of the pelvic veins is heralded by sudden high rise of temperature with rigors towards the end of the second week of puerperium. There is a daily rise

or even a double rise of temperature in 24 hours with rigors and the patient is acutely ill with rapid pulse, abdominal pain and tenderness.

Frequently, the infection spreads to the femoral vein on one or both the sides causing tenderness and oedema of the lower extremities. Tenderness of the calf muscles is an important clinical sign. Infective emboli from the pelvic veins may reach distant organs. In pre-antibiotic era, serious and fatal complications commonly resulted from emboli reaching the lungs and other organs. *Pyaemia* from repeated infections of minute emboli then used to cause abscesses in different parts of the body.

Phlegmasia Alba Dolens (White Leg). It is not a result of femoral thrombosis but is due to lymphatic spread. The leg becomes white, markedly swollen and the oedema is non-pitting in character. The oedema remains permanent and gives rise to considerable disability. Prompt treatment of puerperal infection by antibiotics has practically eliminated this erst while common complication.

Generalised Infection. Septicaemia and General Peritonitis. These two conditions are usually associated. Fulminating septicaemia occurs in neglected cases of rupture of the uterus, or after a caesarean section on a grossly infected case. It is a serious complication after criminal abortion. The causal organism is almost invariably the streptococcus haemolyticus.

The onset is sudden with high temperature accompanied by rigors. The pulse is over 130 per minute. Distension of abdomen and vomiting are evidences of severe toxicity. Nowadays, with prompt treatment with penicillin, further progress is arrested but when the case is neglected, the condition worsens. The patient gets drowsy and dies. (Fig. 140).

Treatment

Prophylaxis. Most of the prophylactic measures have already been stressed and need mere mention to refresh the memory.

During pregnancy, anaemia and toxæmia should be detected and corrected in their early stages, as both these conditions lower the resistance and predispose to puerperal infection. Nutritious diet, rich in minerals and vitamins, is a necessary prophylaxis.

Leucorrhoea during pregnancy should be attended to. Coitus during the last weeks before term should be avoided.

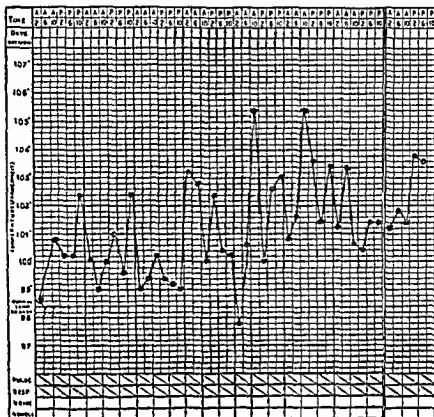


Fig. 140. Temperature chart of septicaemia.

Labour room asepsis, both during normal and instrumental delivery, is important. Vaginal examinations should be performed under strict antiseptic precautions and should be as few as possible. Rectal examination instead of a vaginal examination is frequently advocated but a vaginal examination gives *much more information* as to the progress of labour than a rectal examination and, when performed carefully, does not materially add to the risk of infection.

All lacerations should be carefully sutured and, after an instrumental delivery, a speculum examination to detect lacerations of the vagina and the cervix must be routinely carried out.

The placenta should be carefully examined as pieces of placenta left behind may not cause immediate bleeding but are likely to cause uterine infection.

The attendant and all the personnel in the labour room should wear masks and gowns. No person suffering from naso-pharyngeal infection should be allowed in the labour room.

The advent of sulphonamides and, later, of antibiotics has revolutionised the eradication of infection in any part of the body, and the achievements in the control of puerperal infections may rightly be considered as remarkable. Until then, puerperal sepsis topped the list of the causes of maternal deaths in all countries but, at the present time, it has gone considerably down in the list. Even in the rural areas where organised obstetric aid is not always available, the use of antibiotics by local medical men and untrained women attending on such cases has to some extent mitigated the grave risks of puerperal infection.

It should, however, be emphasised that though antibiotics have made the management of puerperal infection much simpler yet the general principles underlying treatment of infection still apply to the management of puerperal sepsis, and it is as a result of combining the two that the risk of serious complications and sequelae resulting from puerperal sepsis can be markedly reduced.

The general principles in the treatment of puerperal infection are: (1) specific treatment by antibiotics, (2) adequate drainage of localised pus formation, (3) symptomatic treatment, and (4) measures to build up body resistance to infection.

Specific Therapy. The proper application of antibiotic therapy is to identify the causative organisms by uterine culture and to do sensitivity tests to ascertain the most effective drug against the particular organisms, but it takes several days to obtain proper laboratory reports. As penicillin is effective against most of the organisms responsible for puerperal infection, and streptomycin is specific for colon group of bacteria, combined penicillin and streptomycin should be given. Aqueous penicillin, 500,000 units twice a day combined with $\frac{1}{2}$ gm. streptomycin, is an adequate dose for mild localised infection. For more severe forms of infection, larger doses of penicillin will be necessary. In penicillin sensitive patients, tetracyclin, chlortetracycline or oxytetracycline is given orally, intramuscularly or intravenously, depending on the severity of the infection.

Sulphonamides were the first chemotherapeutic drugs employed in the treatment of infection. Though penicillin, streptomycin and tetracycline group of drugs have been employed more and more, there is still a definite scope for the use of sulphonamides in the treatment of puerperal infection. Sulphonamides may be relied on singly or a combination of sulphonamide and penicillin therapy may be employed. For urinary infection, sulphonamide therapy is

superior to antibiotics. Staphylococcal infections of the perineal region yield better results with sulphonamide therapy.

Drainage of Localised Pus Formations. Infected perineal wound is treated by removing the stitches and allowing free drainage. The open wound is allowed to granulate and heal by secondary intention.

Infected lacerations of the upper part of the vagina or the cervix are similarly treated by removing the stitches. To minimise the chances of the spread of infection to the pelvic cellular tissues, 2 ounces of glycerine acriflavine or glycerine mercurochrome is instilled in the vagina once or twice a day for a few days.

Puerperal pyometra is suspected when no cause for purulent discharge is found in the vagina or the cervix on speculum examination, and the uterus is enlarged, tender and has failed to involute. Pyometra is easily drained by passing No. 6 or 8 Fenton's dilator through the patulous cervix. Prior to antibiotic's era, intrauterine instillations of glycerine acriflavine were employed after draining the pus to keep the uterine cavity clean.

Symptomatic Treatment. Pyrexia. Unless the rise of temperature is over 104° F., direct measures to lower the temperature by giving antipyretic drugs or sponging the body with wet packs is not necessary.

Sleeplessness. Sleeplessness due to pain is relieved by giving injection of morphia, $\frac{1}{4}$ gr., or pethidine, 100 mg. Sleeplessness due to pyrexia and toxæmia can be controlled by oral administration of barbiturates.

Abdominal Distension. Paresis of the intestines and the urinary bladder occurs when there is pelvic or general peritonitis. Besides giving large doses of antibiotics to reduce intestinal toxæmia, intravenous infusion fluids, carbachol, prostigmine and calcium pantothenate are helpful. Overdistension of the bladder may need repeated catheterisation.

Anaemia. Puerperal infection frequently occurs in anaemic women. In severely anaemic women, infection is, at times, not controlled by antibiotics until anaemia is treated by giving blood transfusion.

Diet. The diet should be light but of high caloric value, containing more proteins in the form of milk, meat and jellies. Carbohydrates are given in the form of fruit juices. Rich fatty foods are avoided. Vitamins are supplemented by giving proprietary preparations. Fluids are allowed to be taken freely.

Breast Feeding. In mild localised sepsis, breast feeding should

not be interrupted but in severe infections breast feeding is discontinued because very little milk is secreted and it exhausts the mother.

Treatment of Local Pelvic Infection. The general and specific treatments are continued but larger doses of antibiotics are necessary. Combination of antibiotics and corticosteroids helps to control the infection more effectively than when antibiotics are given alone. In uncontrolled pelvic infection, collections of pus may occur and free drainage by abdominal incision or by colpotomy should be done without delay. It should be realised that suppuration of pelvic cellulitis takes 2-4 weeks and, until local signs of suppuration appear, incision into the inflamed cellular tissues is futile and should be withheld.

Pelvic Thrombophlebitis. It is a very grave complication and may prove fatal by massive pulmonary embolism. Besides specific therapy, anticoagulants form an important part of the treatment. Anticoagulants check the spread of thrombus, relieve pain and reduce the danger of pulmonary embolism. The dosage of anticoagulants must be regulated by repeated estimations of prothrombin time and therefore this therapy is not available to all. Care should be taken to maintain the prothrombin time at 20 to 30 per cent of normal.

Oral therapy takes 12 to 18 hours before it begins to be effective and therefore heparin, 15,000 units, is given intravenously for immediate action. Heparin is discontinued as soon as prothrombin time can be controlled by oral therapy.

Examination of a Case of Pyrexia during Puerperium

Puerperal Pyrexia. A rise of temperature occurring after the first 24 hours of delivery must be thoroughly investigated. The majority of cases of rise of temperature following childbirth are due to puerperal genital infection, but a complete examination of all the other systems must be made as quite a number of cases are of extragenital origin. Until proved otherwise, pyrexia during puerperium should be regarded as puerperal sepsis.

Puerperal sepsis is particularly likely after a prolonged labour, instrumental delivery or intrauterine manipulations. Where pyelitis has been a complication of pregnancy, there is great likelihood of it complicating puerperium as well. Another common cause of infection of the urinary tract during the puerperium is repeated

catheterisation. Congestion of the breasts or mastitis is a common cause of pyrexia and should always be excluded. Active pulmonary tuberculosis or 'flare up' of a latent focus during puerperium is not uncommon in India. Respiratory tract infection is prone to occur during puerperium, when inhalation anaesthesia has been given for delivery. Mild puerperal uterine infection is commonly observed in severely anaemic women, and in those whose pregnancy has been complicated by severe pre-eclampsia or eclampsia. Besides these, a puerperal woman may contract any other intercurrent medical or surgical disease. Though malaria has been eradicated from many parts of the country yet its possibility in cases of unexplained pyrexia must be kept in mind. Lastly, virus hepatitis, at times, complicates puerperium, particularly when plasma or blood transfusions have been given during the third trimester of pregnancy.

Diagnosis of Puerperal Pyrexia

General Condition of Patient. The rise of temperature in genital infection is usually on the third day. In mild localised infection, the rise is seldom greater than 100° - 102° F. A sharp rise to over 102° F. indicates severe infection, particularly when it is accompanied by rigors. In congestion of the breasts, mastitis or pyelitis, the rise is also high and with a chilly feeling which should be distinguished from rise with severe rigor. In malaria there is sudden high rise of temperature with rigor.

The toxicity of the patient should be observed and considered together with pyrexia. Pulse rate of not more than 100 per minute, though the range of temperature is high, indicates low toxicity and is observed in pyelitis and malaria. When rise of temperature is up to 102° F. and the pulse rate does not exceed 120 per minute, the patient is moderately toxic but when the pulse rate is over 130 it is of grave prognosis irrespective of the range of temperature. Generally, a patient who sleeps well and has a good appetite indicates mild toxicity.

In localised puerperal infection, the temperature is intermittent, has a short range of variation and gradually becomes lower and touches normal within a week. In pyelitis, malaria and generalised infection, the temperature is intermittent with a daily rise with rigors and, in some, the rise and fall of temperature occurs twice in 24 hours. As mentioned above, the range of pulse is a reliable guide as to the gravity of the infection.

Examination of Patient. The chest is exposed and the breasts

are palpated. Congestion of the breasts occurs on the third or the fourth day. The breasts become tense and hard, and the skin becomes red and shiny. They are hot and tense and are acutely tender. As a rule, the congestion is due to blocking of the ducts by thick colostrum. There may be cracks or fissures on the nipples. After palpating the breasts, the lungs are examined by percussion and auscultation.

During abdominal examination, the uterus is palpated. In uterine sepsis, the uterus is subinvolved and is tender. When infection has spread to the pelvic tissues, a tender, inflammatory mass may be palpated in the lower abdomen on one or both the sides. Occasionally, a tender pelvic tumour is palpated which may have got infected. Tenderness in the lumbocostal angle, on one or both the sides, is a reliable sign in pyelitis, more so if the patient complains of backache in that region.

The episiotomy or perineal wound is examined. When a perineal wound is infected, the patient usually complains of throbbing pain in the region. The area around the sutures appears red and oedematous, and is very tender. Pus may be squeezed on pressure along the suture line. Even when there are no perineal sutures, the vulva should be carefully inspected as a haematoma, resulting from an undetected tear, may have got infected. A speculum examination for lacerations of the upper part of the vagina or the cervix is indicated when there is profuse, purulent vaginal discharge.

A digital, vaginal examination should not be made as it does not aid diagnosis and is likely to do more harm by spreading the infection. Should, however, the temperature persist for more than a week, a bimanual vaginal examination is indicated to exclude the spread of infection to the pelvic tissues.

Investigation. A routine blood count is valuable. Leucocytosis upto 10,000 cells per c.mm. is normally present for a few days after childbirth, but a count higher than that with increase in the percentage of neutrophils indicates infection. In malaria there is no leucocytosis. In pyelitis there is usually some leucocytosis but, sometimes, the W.B.C. count is normal. Besides leucocytosis, the presence and the degree of anaemia should be noted. The lowered resistance due to severe anaemia will need blood transfusion and other counter measures.

Urine should be examined and, though a catheter specimen would be the best, it is better to avoid catheterisation and instead

collect a midstream sample after carefully cleaning the vulva and putting a sterile tampon in the introitus. Presence of more than five pus cells per high power field in the centrifuged deposit indicates urinary infection.

The advisability of routinely taking a swab for smear and culture examination from the uterine cavity is not universally accepted. Normally, the uterine cavity is contaminated by vaginal organisms by the sixth puerperal day, and therefore a uterine swab, to be of any diagnostic value, should be taken before the fifth day. After inserting a speculum and cleansing the vagina and the cervix, a tube is inserted high into the uterine cavity carrying within it a swab. The swab is pushed into the highest part of the cavity and withdrawn into the tube and the tube with the swab is withdrawn and smears and cultures made. It is argued that by knowing the offending organisms, sensitivity tests can be carried out and the proper antibiotics administered. In majority of instances, the organisms are sensitive to penicillin and other broad spectrum antibiotics and therefore taking of a swab and testing for the offending organisms is of not much clinical value. However, smear and culture examination is important in tracing the source of infection.

PUERPERAL TETANUS

Puerperal tetanus is a grave complication in obstetrics. It is hardly ever met with in Western countries but it is not so rare in tropical countries. Puerperal tetanus is subdivided into *postabortal* and *postpartum* cases. The *postabortal* cases are commoner and carry a graver prognosis than *postpartum* cases.

Incidence. As tetanus is not a notifiable disease in India, the correct incidence in the rural and the urban parts is not known. Most of the cases reported are those admitted for treatment in the hospitals of large towns. In 1959, Patel and Joag reported 68 cases of puerperal tetanus in a total of 1398 cases treated at the K.E.M. Hospital, Bombay, during the four-year period 1952-1955. Patel et al reported from the Nair Hospital, Bombay, 403 cases of tetanus in which there were 28 cases of puerperal tetanus during the three-year period, 1959-1961.

Predisposing Factors. Illiteracy, low living standards and lack of hygiene are the chief predisposing factors in underdeveloped countries like India. The post abortal cases are more serious because of criminal interference by an abortionist, who is more of a quack or a 'dai' than a qualified person. Because of the veil of

secrecy surrounding a criminal abortion, even a qualified person is often unable to carry out the procedure with proper aseptic measures. A variety of substances are employed for procuring criminal abortion, the common ones being sticks, laminaria tents, rubber tubes and irritant pastes.

Classification. Patel and Joag have devised a classification, mainly from the point of view of assessing prognosis. They have found that the shorter the period of onset (interval between lockjaw and the first convulsion) the more severe is the prognosis. In their series, when the period of onset was less than 24 hours, the mortality rate was about 77.6 per cent, while, when the period of onset was between 24 to 48 hours, the mortality was 49.7 per cent. When the onset was delayed to more than 96 hours, the mortality was as low as 13.9 per cent. The determination of the interval between the first symptom, lockjaw and the first convulsion, is a very reliable guide in assessing the prognosis.

Another factor of grave prognosis was high temperature or persistence of temperature in spite of adequate treatment.

In Patel and Joag's classification, the five criteria used in grading are: (1) lockjaw, (2) spasms, (3) incubation period of 7 days or less, (4) period of onset (as defined above) of 48 hours or less and (5) axillary temperature of 99° F. or rectal temperature of 100° F. on admission or within 24 hours of admission into the hospital.

Grade 1 consists of mild cases which have only one of the above criteria and these carry no mortality.

Grade 2 will have any two of the above, usually lockjaw and spasm. In this grade the incubation period is longer than 7 days and the period of onset more than 48 hours.

Grade 3 will have any three of the above five criteria, the two constant being lockjaw and spasm. The incubation period is the important criterion, a one of less than 7 days carrying a high mortality of 60 per cent. Prognosis becomes worse if rise of temperature is the third criterion.

Grade 4 will have four of the above five criteria. The mortality is high when any of the following three are present: (a) incubation period of less than 7 days, (b) period of onset less than 48 hours and (c) temperature.

Grade 5 will have all the five criteria. The majority of cases of tetanus neonatorum and puerperal tetanus fall in this group.

Grade 5 cases carry a high mortality. In Patel and Joag series, it was 83.5 per cent.

Complications and Prognosis. (1) Pulmonary complications are frequent and dangerous. (2) Hyperpyrexia and toxæmia. (3) Repeated spasms, convulsions and exhaustion. These complications carry a high mortality rate.

Other factors affecting the prognosis are, age and the clinical type. Between two patients of the same grade, the prognosis is graver for the older patient. Postabortal tetanus carries a higher mortality than postpartum cases. In the series reported by Patel et al., the mortality for postabortal cases was 75.5 per cent and for postpartum cases it was 45.5 per cent.

Treatment. The routine adopted is as follows. The patient is kept in a quiet room. Reid et al. stress the importance of nursing these patients in the prone position to avoid pulmonary complications, but for practical purposes it is important to change the posture of the patient frequently and to aspirate the upper respiratory tract as and when necessary.

Depending on the severity of the disease, narcotic drugs are given intramuscularly or intravenously. The drugs are repeated frequently enough to produce sleep.

Nutrition is maintained by intravenous drip of 5 per cent glucose solution. The fluid intake is restricted to two litres (3 to 4 pints) per day. Nasal feeding is best avoided because in tetanus the larynx is no longer a watch dog for the lungs.

After testing for sensitization to antitetanus serum, 10,000 units of serum is given once, intramuscularly.

For the prevention of pulmonary complications, crystalline penicillin, 5 lac units every 6 hours is given intramuscularly. Atropin is given to minimise the bronchial secretions.

Venous Thrombosis

Thrombosis of the veins of the lower extremities occurs during the puerperium, though it very occasionally occurs during pregnancy. It is necessary to differentiate two types of thrombosis: (1) *Thrombophlebitis* in which inflammation of the vein is the primary condition and, as a result, there is secondary thrombosis. Rise of temperature, swelling pain and tenderness are the usual clinical features. (2) *Phlebothrombosis* is unassociated, with inflammation of the vein, and thrombosis is the primary event. It frequently re-

mains undiagnosed except when generalised oedema of the lower extremity or the manifestations of pulmonary embolus occurs.

Predisposing Factors. (1) During pregnancy and puerperium, viscosity and clotting tendency of the blood is greater. An increase in the number of platelets during puerperium is partly responsible for this greater viscosity.

(2) *Venous Stasis.* Slowing of the venous blood flow is an important factor in initiating thrombosis. Prolonged immobilization of the lower extremities, anaemia and dehydration are causative factors for venous stasis. The general opinion is that all thrombosis commences in the deep tibial veins of the calf and from there extends upwards.

(3) *Infection.* Low grade infection of the genital canal during the puerperium may result in thrombosis of the pelvic veins.

Pathology. In the non-infective *phlebothrombosis*, the thrombus gets adherent to the vessel wall within a week after its formation. Soon after, the adherent thrombus gets organised and becomes firmly adherent to the vessel wall. However, the proximal extension of the thrombus hangs free for a considerable distance, though the thrombus at the site of origin is firmly adherent, and this loose extension may break off to lodge in the pulmonary artery at any time.

On the other hand, in the infective *thrombophlebitis* the inflammation of the vessel wall fixes the entire length of the thrombus firmly to the vessel wall and, as a result, there is minimal danger of massive pulmonary embolism occurring in this condition. At times, small thrombi are likely to get dislodged to cause metastatic embolic phenomenon in the lungs and other parts of the body. Pyaemic abscesses occur only when the pelvic infective process is very severe.

Non-infective Phlebothrombosis. *Deep Venous Thrombosis* It commences in the deep veins of the calf or sole and extends upwards. It is to be suspected when a patient complains of pain in the calf or along the course of the femoral vein. Tenderness in the calf or popliteal region is usually present. Pain on sharp dorsiflexion of the foot (Homan's sign), when present, is a useful sign. If the thrombosis spreads upwards, there is generalised oedema of the leg. But, even slight oedema is of clinical importance in a patient who complains of pain and tenderness in calf. Apart from slight rise of temperature there is no other constitutional disturbance.

Frequently, the condition remains undiagnosed until the sudden development of pulmonary embolism.

Superficial Venous Thrombosis. It usually occurs in limited portions of a superficial varicose vein. It seldom spreads to the deep veins, but it may extend up the saphenous vein and from there to the femoral and iliac veins. Clinically, it occurs on the third or the fourth day of the puerperium, and is readily diagnosed from the hard and painful nature of the affected vein.

Infective Thrombophlebitis. It is usually preceded by puerperal infection of the genital tract. The offending organism is usually the anaerobic streptococcus. The common infective process is pelvic cellulitis giving rise to pelvic thrombophlebitis. By retrograde spread, thrombosis of femoral vein occurs. It occurs more frequently in anaemic women, probably due to increased viscosity of the blood and venous stasis.

Clinically, the condition is manifest towards the end of the second week of puerperium by high temperature with chilly feeling. There is acute pain in the affected limb and tenderness is elicited in the region of the femoral vein and, in some cases, above the Poupart's ligament. Oedema of the whole leg occurs within a few hours of the onset. Frequently, as a result of arterial spasm, there is pallor of the extremity and the condition is frequently wrongly described as "phlegmesia alba dolens".

Treatment

Propylaxis. Immobilization of the limbs is an important factor towards causing venous thrombosis, and the risk of puerperal thrombosis has been considerably lessened by early ambulation, and leg exercises should be commenced from the first day. With proper suturing of the episiotomy or perineal wound, the patient can be allowed to get out of the bed from the third day. Early ambulation of anaemic patients is particularly important. Sepsis should be adequately treated from the start by antibiotics.

Early recognition of deep venous thrombosis of the legs is important, and attention should be paid to any complaint of pain in the calf region. Pain in the calf by sharp dorsiflexion of the foot is an important early sign.

Management. The important principles underlying treatment of venous thrombosis are: (1) General nursing; (2) antibiotic treatment, (3) anticoagulant therapy, (4) venous ligation, and (5) sympathetic nerve block.

General Nursing. Immobilisation of the affected limb is not necessary. The patient is nursed in bed with a cradle over the leg to allow mobility, and also to prevent pressure from bed clothes. Soon after the patient has become afebrile she is allowed to walk, preferably with an elastic bandage on the limb to prevent increase of oedema in the standing position.

Antibiotic Treatment. In febrile cases, antibiotics should be given to reduce the chances of pelvic venous thrombosis from genital infection. When signs of pelvic venous thrombosis are evident, intensive antibiotic treatment must be administered.

Even in phlebothrombosis of the veins, antibiotics should be given prophylactically.

Anticoagulant Therapy. Since the introduction of anticoagulants, the main form of therapy is to give anticoagulants so as to prevent the formation of fresh thrombi, and to minimise the danger of pulmonary embolism. To be effective, early diagnosis of deep venous thrombosis should be made. These drugs demand constant vigilance lest spontaneous bleeding from other mucous membranes should occur. The object of this therapy is to keep the blood clotting time between fifteen to twenty minutes. These drugs can only be given when proper laboratory facilities for estimating prothrombin time are available.

The anticoagulant drugs in common use are Heparin, Tromexan, Dicoumarin and Dindevan.

The treatment is initiated by giving Heparin which has a rapid effect of retarding the coagulation time. The anti-coagulation effect is obtained within a few hours of intravenous or intramuscular injection. About 50 to 100 mg. is given intramuscularly every 4-6 hours so as to maintain the coagulation time between 15 to 30 minutes.

Simultaneously, oral therapy by Tromexan or Dicoumarin is started and Heparin is discontinued when therapeutic prothrombin time is achieved. The object is to increase the prothrombin time by about $2\frac{1}{2}$ to 3 times. As a rule, the daily maintenance dose of Dicoumarin is 50-150 mg. Tromexan, which is rapidly absorbed and rapidly eliminated, requires a dosage of 600-900 mg.

Venous Ligation. Before the introduction of anticoagulant drugs, the only preventive measure against pulmonary embolism was venous ligation. The only indication for its employment would be in pelvic thrombophlebitis which does not respond to antibiotic treatment. It may be then necessary to ligate the iliac veins.

Ligation of the vena cava and even the ovarian veins have been sometimes life-saving measures.

Engorgement of Breasts

Engorgement of the breasts usually occurs on the third or the fourth day after delivery. Besides causing acute discomfort to the patient, there is the risk of development of acute mastitis. Slight engorgement at commencement of active breast secretion is inevitable and usually subsides within 24 to 48 hours. Severe engorgement is often due to improper prophylaxis and is preventable to a large degree. The frequency with which engorgement and mastitis develop reflects the vigilance and care by the nursing and the medical staff.

Prophylaxis. The prophylaxis should be begun during the later half of pregnancy. The expectant mother should be advised to wash daily the nipples and the surrounding areola with soap and water. After washing, the nipples are gently pulled so that they may protrude sufficiently for the baby to suck. If the nipples are retracted, earnest attempts should be made daily to pull the nipples out from their depressed position.

When the newborn is put to the breast on the second day after delivery, the nurse should instruct the patient to squeeze the breasts gently towards the nipples to remove the thick colostrum. By so doing the newborn receives some nutritive material but an equally important purpose is to remove the thick colostrum which otherwise would block the ducts and prevent the flow of milk when it is secreted on the third day. When this simple prophylaxis is neglected, severe engorgement of the breasts on the third or the fourth day is inevitable. The breasts become hard and tender, and the skin over it is tense and shiny. The engorged veins under the skin can be seen running in different directions. When there is a chilly feeling with rise of temperature, 10 lac units of penicillin, once or twice a day, is an important prophylaxis against the development of acute mastitis and breast abscess.

Treatment. The breasts are well supported by a properly fitting brassière. Pain is relieved by any of the proprietary preparations containing codeine. The patient is instructed to cut out liquids as much as possible and not to partake soups or "rawa kanji" which stimulates breast secretion. Ethynyl oestradiol, 0.05, or stilboestrol, 5 mg. tablet, once or twice a day for just one or two

days, helps considerably in temporarily slowing down the secretion of milk and thus relieving congestion. Oestrogens should not be used in larger doses and, as a rule, for not more than 2 days for fear of completely suppressing the secretion of milk.

Cracked Nipples

Cracks may appear over the nipple in the duct bearing area or at the base of the nipple. Cracking of the nipple is usually due to the neglect in preparing the nipples during pregnancy for lactation. In the warm climate of India, the nipples are kept supple by the daily application of olive oil over it at bed time. The patient should be advised to clean the nipples with soap and water but not to scrub it. It should be gently dried after washing. By these precautions, the nipples are prepared for sucking by the infant.

The value of care of the nipples throughout lactation should be properly explained. Most women wash the nipples with mild boric lotion before putting the infant to the breast but many neglect to clean the nipples after feeding. The milk drops, remaining on the surface of the nipple after feeding, dry and form a crust over it which predisposes to cracking of the nipples. The patient should, therefore, be explained the necessity for cleaning the nipples after feeding and warned that neglect will lead to cracks and interruption of breast feeding. After cleaning the nipples, the nipple area should be kept covered by a piece of sterile gauze until the time of the next feed. This prevents any possible source of entry of organisms. These simple measures are very important and proper emphasis should be laid on their importance during the training of nurses and students.

Treatment. Small cracks are not so tender as not to allow the infant to be nursed directly but when direct breast feeding becomes very painful to the mother, a nipple shield should be used. When sufficient milk is not drawn through a nipple shield, it is necessary to express the milk by hand and feed the baby. Rarely, the cracks are so persistent that it becomes necessary to discontinue breast feeding altogether.

The cracks at the base of the nipple can be effectively sealed by the application of Tinc. Benzoin by means of a thin strip of cotton wool wrapped over a fine stick. Cracks over the nipples are also similarly treated, but great care should be taken not to seal up the surrounding openings of the ducts. Healing is delayed

by stretching the skin to see whether the cracks have healed, as in so doing the healing cracks are once again opened. This disadvantage should be explained to the mother and she should be instructed not to do so. Application of Tinc. Benzoin is best done at night after the last feed and every 12 hours thereafter until the cracks have healed.

Alternatively, the affected nipple is covered with lanoline or castor oil. The application is removed before each feed by washing with methylated spirit and mild boric acid lotion.

Inhibition of Lactation

Whenever initiation or continuation of lactation is considered inadvisable, it is necessary to check the secretion of milk.

Indications. (1) Premature labour with birth of a non-viable foetus, stillbirth or neonatal death of the foetus.

(2) Retracted nipples which cannot be everted by mechanical methods.

(3) Acute mastitis with formation of a breast abscess.

Treatment. A tight binder should be applied for the uplift of the breasts. Fluids by mouth are restricted. Ice cold compresses should be applied to the breasts several times a day. Breast pump should be used sparingly, as the frequent use of a breast pump stimulates secretion of milk into the emptied breasts. Discomfort to the patient, as a result of engorgement, is relieved by analgesic tablets.

Both, oestrogens and androgens inhibit lactation. Injection of Clinoestrol, 5 mg. once a day for 3-4 days, followed by stilboestrol, 5 mg. tablets three times a day for the next 3-4 days or, if androgens are used, methyl testosterone tablets, 10 mg., three times a day for 3-4 days, are sufficient to inhibit lactation.

Acute Lactational Mastitis

Acute mastitis during the puerperium, particularly the one which proceeds to abscess formation, should be an infrequent complication and its frequent occurrence is a reflection on the neglect of proper supervision by the nursing and the medical staff. Besides the usual prophylactic measures, the incidence and course of acute mastitis have been markedly influenced by penicillin. Provided antibiotic therapy is started early, very few cases of mastitis should develop breast abscess.

Predisposing Factors. (1) *Engorgement of the breasts* is not unusual but when engorgement is allowed to persist for several days, the stasis of milk becomes a favourable medium for organisms to grow. Therefore, attention towards the prompt relief of engorgement is an important prophylactic measure.

(2) *Cracks and fissures on the nipples* not only prevent proper emptying of the breasts but, through them, organisms can find an easy access to the breast parenchyma.

Causal Organisms. The most common offending organism is the *staphylococcus aureus*. Haemolytic streptococcus is occasionally encountered and mastitis, as a result of it, is more grave.

Site of Mastitis. In most of the cases, it is in one sector of the parenchyma of the breast. In some cases, the infection is superficial just underneath the skin of the areola, and is a localised infection of one of the Montgomery's follicles.

Clinical Features. Mastitis usually appears towards the end of the first week of puerperium but, not infrequently, during the second or the third week after the patient has been discharged. This late appearance is due to neglect of the breasts by her at home. Therefore, not only is it important to pay proper attention to the breasts while the patient is under the supervision of the nursing staff but also to give proper instructions as to how she should attend to her breasts and point out the grave complications likely to follow the neglect on her part at home.

Marked and prolonged engorgement usually precedes the inflammatory process. Acute, continuous pain in the whole breast, which later localises to one sector, is a constant symptom. An early symptom is repeated chilly feelings or actual rigors, followed by sharp rise of temperature. At this stage, the inflammatory process can be reversed by prompt local measures and large doses of penicillin injections.

The initial uniformly hard engorged breast is followed by a hard localised area of tenderness, the skin over which is red. On pitting the skin, it blanches to become red immediately on release of pressure. Many patients complain of pain in the axilla of the corresponding side and, if suppuration occurs, axillary lymph glands are enlarged.

Treatment. Prophylaxis is most important. Prompt measures should be taken to relieve engorgement. Measures to prevent the development of fissures on the nipples and proper treatment if they appear is also an important prevention. When these two predis-

posing factors are properly supervised and treated, the incidence of mastitis should be very infrequent.

Once mastitis has occurred, the infant should not be put to the breasts and the milk should be dried by giving oestrogens or androgens. Ten lac units of penicillin should be injected every six hours. Relief from pain is given by analgesic drugs and adequate sleep by hypnotics. By these measures the inflammatory process may be reversed.

Breast Abscess

When early measures to check mastitis are not taken, the inflammatory process is very likely to proceed to suppuration. As mentioned before, the breast abscess may be small and superficial under the skin of the areola, or large and deep into the breast parenchyma. Usually, it is unilateral but may be bilateral.

Clinical Features. The temperature persists and may be intermittent with rigors or continuous. There is pain and acute tenderness over the inflamed region. The inflamed part is red, hot and hard in the beginning but, after a few days, there is a softening in the centre of it with fluctuation. The appearance of this central, fluctuating area confirms that suppuration has occurred and indicates where the abscess should be opened.

Treatment. Except for the small abscess beneath the areolar skin, all the deep abscess must be opened under inhalation or intravenous pentothal sodium anaesthesia. The small superficial one can be incised under local ethyl chloride spray.

For both, superficial and deep abscesses, the incision should be radiating and not transverse because, by a radiating incision, damage to the surrounding parenchyma and the ducts is minimal.

An incision, 2 cm. long, radiating from the nipple is sufficient to drain a superficial abscess. Healing occurs within the next few days.

For a deep parenchymal abscess, a liberal incision should be made and all the loculi should be broken by inserting the index finger through the incision as otherwise pockets of pus will be left behind. Into the single abscess cavity, a drainage tube is inserted and brought out through a counter incision in a dependent area.

Supernumery Breasts

Supernumery breast tissue, with or without a nipple over it, is now and again observed in any part along a line extending from

the axilla to the umbilicus. The supernumerary tissue is usually bilateral. The commonest site for supernumerary breast tissue is the axilla where a painful tender swelling develops during early puerperium which regresses within a few days.

Psychosis Associated with Pregnancy and Childbirth .

A small percentage of patients during pregnancy shows signs of mental illness. Symptoms might appear in patients that are normal before pregnancy, but often a history of previous attacks or some kind of mental illness in the patient or her family is available. The illness often comes in the later part of pregnancy. It begins with sleeplessness, irritability, loss of interest or feeling of exhaustion. At times, the patient develops depression or maniac excitement or shows a tendency towards withdrawal from reality. She may seem preoccupied, stare vacantly and get delusions or hallucinations.

Much more common than the above mentioned condition is the psychosis that follows childbirth. Puerperal sepsis increases the chances of this illness in a susceptible woman. Generally, the illness begins within ten days to one month after childbirth, but in any particular case one cannot predict the possibility of psychosis in subsequent deliveries just because the patient had post partum psychosis following her previous delivery. There are mainly three types of clinical features in this condition: (1) toxic confusional reaction, (2) maniac depressive reaction, (3) schizophrenic reaction.

In the first type the patient's general health is often poor, she may be undernourished, and have a toxic look, with fast pulse or a rise of temperature. She gets confused and may not be able to recognise those around, shows disorientation regarding time and place. Delusions and hallucinations are common.

In the second type, the patient who was apparently well during pregnancy, gradually becomes sleepless, irritable, refuses to take food, and may have bouts of excitement. She may show complete disregard for the newly born child and even throw the child away. She sometimes becomes violently excited with her husband and relatives, with whom she was previously well adjusted. She often shouts loudly without any reason, giggles or laughs without provocation and may become abusive and assault other persons. On the other hand, she may show depressive tendencies, so that she

becomes morose, sullen and seclusive and refuse to take meals, cry without reason, complain that she is worthless and useless and may even attempt suicide.

At times, a patient may show schizophrenic tendencies. She slowly withdraws her interest from the world around, neglects her child, avoids family members and constantly seems preoccupied, thinking about nothing in particular. It looks as if she is in a dream world of her own and maintains rigid posture or rigid expressions for a long time and may resent interference. She may laugh or cry on her own and refuse to talk or appreciate jokes. Her talk sometimes becomes incoherent and her actions irrelevant. At times, she shows impulsive behaviour like jumping out of the window or assaulting her child. She may develop delusions of persecution.

As a rule, prognosis is good in the first and second type. A patient with the toxic confusional state generally comes back to normal, if she sleeps well on medication and takes proper nourishment. A patient with maniac depressive features may be very difficult to manage; she may have to be kept under restraint. Although, the condition may look very serious in the beginning, she gradually comes back to normal. An average patient comes around in about 6-12 weeks, but in some cases the illness may continue for a longer time.

The schizophrenic reaction is more difficult to treat. The sickness does not come under control as quickly as in other two types.

Treatment. For psychosis associated with pregnancy or childbirth active therapeutic measures are needed. Segregation from the family members is generally advisable. The patient should not be left alone but constant nursing is necessary because of the risk of their harming themselves or others. The newly born child also should be kept away from the mother. The patient might be allowed to sleep for 11-14 hours a day. If the nourishment is not proper, extra nourishment by mouth, i.e. iron and other minerals, liver, vitamins, should be given. Adequate combination of suitable tranquilizers is useful to decrease agitation, depression, excitability, etc. Electrical Convulsive Therapy or Insulin Coma Therapy might be needed for resistant cases. Psychotherapy is indicated for the study and treatment of the problems that have contributed to the patient's illness.

Physical Therapies. Some other treatments used in psychiatry are only mentioned here as ordinarily an obstetrician is not called upon to use these therapeutic measures. Carbon dioxide treatment

along with psychotherapy is found to be useful in psychosomatic conditions. Insulin Coma and Electrical Convulsive Therapies are useful in post partum psychosis.

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SECTION XII

MISCELLANEOUS

CHAPTER 1

MATERNAL MORTALITY

Definition. The maternal mortality rate is calculated as the number of deaths per 1,000 births (live and still, included). At times, maternal death occurs during pregnancy with the foetus still in utero, and would not come under the usual calculation of death rate per 1,000 live or still-births. A comprehensive definition of maternal mortality should include all maternal deaths occurring during pregnancy, labour, and within one month after delivery. There is no uniformity in the calculation of maternal mortality in different countries.

An accurate estimate of maternal mortality in India is not available because deaths occurring during pregnancy and childbirth are not compulsorily notifiable, and many deaths directly related to pregnancy and childbirth and those due to conditions associated with pregnancy are not properly recorded. In India, reports on maternal mortality for the City of Bombay by Jhirad, 1937-38, for the City of Madras by Mudaliar, 1933, and for the City of Calcutta by Neal Edwards, 1936-37, have been published. As these reports pertain to one city for a short period of one year, the correct trend for the whole country cannot be judged. Besides, these reports were published more than twenty years ago and obstetric management has undergone considerable change since then. In this chapter, an attempt has been made to point out the changing trends of the major causes of maternal mortality, by analysing the maternal mortality at the Nowrosjee Wadia Maternity Hospital over a period of thirty years, 1931 to 1960.

Before discussing the various causes of death in pregnancy and childbirth, reference must be made to the factors influencing maternal mortality. These factors broadly fall into two groups: (1) Primary avoidable factors, and (2) Recent advances in obstetric management.

Primary Avoidable Factors

These factors pertain to the environment of the patient, family and population, and are, therefore, more national than obstetric problems.

In India, as in other Eastern countries, poor physique, as a result of malnutrition, is present in a large section of the population. Until nutritional standards of the population are improved, the impact of malnutrition on obstetrics is bound to persist. In the socio-economically advanced countries of Europe and America, malnutrition does not exist, and nutritional disorders, such as anaemia, osteomalacia, rickets and tuberculosis, are rare. In India nutritional anaemia, either directly or indirectly, claims the largest number of maternal deaths. The effect of osteomalacia and rickets is contraction of the maternal pelvis, and thus an increase in the hazards of childbirth.

Rapid increase in population, inadequate housing facilities and overcrowding are national problems. In their trail, they increase poverty and reduce nutritional standards.

Adequate obstetric facilities are a very important means of reducing maternal mortality. In Europe and America obstetric practice is well organized. In India, obstetric facilities have considerably improved in the large cities, but the rural areas—and India is mostly composed of rural areas—are badly neglected.

Regular antenatal supervision has achieved remarkable results, and though good antenatal clinics are available in the large cities of India, still many pregnant women do not take advantage of them due to ignorance. Many of those who do attend the clinics do so at irregular long intervals, and not infrequently, valuable time is lost in detecting and controlling complications. A team of social workers should be available to supervise over pregnant women, and to enforce regular attendance. Adequate number of beds should be available to treat serious anteatal complications.

Though it is true that adequate number of beds during childbirth are not available in maternity institutions, domiciliary practice is not desirable in India with its overcrowded home surroundings, poverty, ignorance and lack of trained nurses. These factors are responsible for a number of deaths in the maternity institutions of large cities of India. The conditions in rural areas are necessarily deplorable, and take toll of large numbers of women in their prime of life.

The scarcity of nurses adequately trained in obstetrics as also of medical personnel, is a major problem in India, particularly in the rural areas. The Nursing Council of India has recently introduced a new cadre of Auxilliary Nurse Midwives Course to supplement the scarcity of trained nurses and midwives in the rural areas, but a number of years will pass in the present scarcity state, before any appreciable improvement occurs.

It will be evident that these groups of factors are either State, Municipal or National problems, and all that obstetrics can do at the present time is to mitigate the effects during pregnancy and childbirth with the aid of valuable recent advances in therapeutics.

Even in England the Report on Confidential Enquiries into Maternal Deaths in England and Wales 1955-57 show that 250 deaths due to pregnancy and childbirth together with 59 associated therewith were considered to have avoidable factors.

During pregnancy the most important basic avoidable factor was inadequate antenatal care. The avoidable factor during labour was poor management during labour. In the hospital service, junior medical staff sometimes attempted difficult operative deliveries unsupervised by their more senior colleagues. Neglect to follow medical advice and refusal to go to hospital were the chief avoidable factors attributable to the patients.

Age and Parity. The maternal mortality rate increases with advancing age and parity. With advancing age, there is increased frequency of hypertension, and a greater incidence of cardiac decompensation. The maternal mortality rises in women who have eight or more deliveries, but this higher incidence due to parity is an additive effect because women who have had a number of deliveries are also advanced in age. It should also be remembered that dietetic deficiencies carried over a number of pregnancies lead to severe anaemia—a major cause of death in underdeveloped countries. Moreover, the incidence of haemorrhage during pregnancy and labour increases with parity.

Recent Advances in Obstetric Management

Blood Transfusions. The free use of blood transfusions since the last twenty years is truly a remarkable advance in medicine, particularly in obstetrics. In the management of cases of severe anaemia, antepartum and post-partum haemorrhage, and obstetric shock, ready availability of blood has been an important factor in

reducing maternal mortality. Senior obstetricians who have been in practice for more than twenty-five years and have witnessed the high mortality in the absence of free use of blood, can really appreciate what a boon blood transfusion is in modern obstetrics.

Antibiotics. Since 1937, when Domagk introduced sulphonamides to the medical profession, rapid strides have been witnessed in the field of antibiotics, and their immense value in modern obstetrics has been primarily in the remarkable lowering of maternal mortality from sepsis. "Child-bed fever", once the biggest cause of maternal deaths, today claims very few deaths. Even post-abortal sepsis, resulting from criminal abortion, has been lowered to some extent through the use of antibiotics by the persons inducing such abortions. It should be noted that, besides antibiotics, better antenatal supervision and intranatal management has also been responsible for the low maternal death rate from sepsis.

The expanding use of caesarean sections in the present day obstetrics is due to the safety afforded by blood transfusions and antibiotics. Today, caesarean sections are performed, even in cases of neglected prolonged labour, in preference to destructive operations because of these two valuable therapeutic advances.

Co-ordinated Obstetric and Medical Measures. Maternal deaths from systemic diseases have been remarkably reduced as a result of close liaison between the obstetrician and his medical and surgical colleagues. Management of patients suffering from cardiac disease, diabetes and systemic tuberculosis, are good examples of what can be achieved by these combined efforts. Results achieved in the care of pregnant cardiac cases at the Boston Lying-in Hospital are notable. Another notable example is the cooperative care of the pregnant diabetic at the King's College Hospital by Peel and Oakley. Failure to secure adequate liaison between the obstetrician and his medical and surgical colleagues, is an avoidable factor and must be eliminated.

For appreciating the changing trends, the maternal mortality at the Nowrosjee Wadia Maternity Hospital over a period of three decades from 1931-60 has been analysed.

Trends in maternal mortality have been analysed under the heading of anaemia, toxæmia, sepsis, haemorrhages and medical disorders. It will be observed that during this period, there has been a decline in maternal mortality from all these five causes. The curves of sepsis and medical disorders show a strikingly consistent fall. There has also been a fall in maternal deaths due to

anaemia. The decline in the rate of mortality from toxæmia, is disappointingly small, whilst that due to haemorrhage seems to be practically unaffected. This is in conformity with figures from Western countries (Fig. 141).

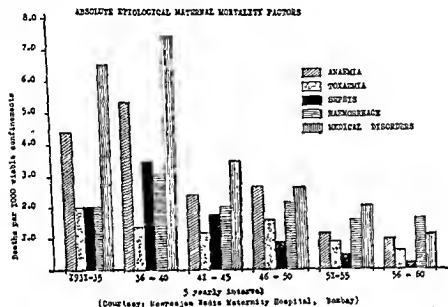


Fig. 141

Analysis of Individual Causes

Anaemia. The problem of anaemia is particularly great in Eastern countries due to poverty, religious bias and malnutrition. Anaemia is more a problem pertaining to the population in general, rather than limited to the maternity state. In view of our low nutritional and economic standards, it appears that anaemia will continue to feature prominently in mortality surveys until the economic standards of the population are raised.

Anaemia accounted for roughly 25 per cent of the total deaths in the years 1931-40. In the next ten-year period (1941-1950) it accounted for 24 per cent deaths and in the last ten year period (1951-1960) it accounted for 20 per cent of deaths (Fig. 142). These figures when reviewed against the background of improved therapeutic measures available in the treatment of anaemia, indicate that anaemia still remains a major contributory cause. The better control of complications associated with anaemia, like infection and medical disorders, have contributed in fair measure to reduce mortality from anaemia.

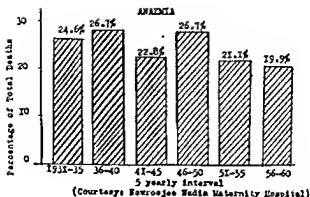


Fig. 142

Toxaemia. There has been hardly any reduction in maternal mortality from this cause, as seen from Fig. 143.

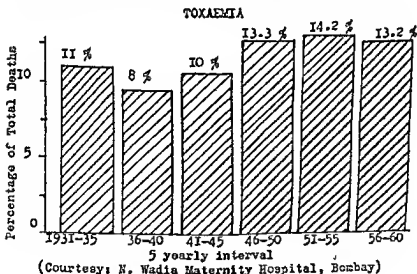


Fig. 143

In view of the recent use of hypotensive drugs and diuretics in the management of toxæmia, a major decline was expected. It appears that a greater awareness on the part of the public regarding the gravity of this cause is essential for further reduction in the mortality rate. More than 75 per cent were emergency admissions.

Sepsis. There has been a remarkable fall in mortality from sepsis, both absolute and in relation to other causes of mortality.

In the first decade (1931-40) sepsis accounted for 16.4 per cent of the mortality. In the second decade (1940-50) it accounted for 11 per cent of deaths, and in the last decade for 4 per cent of deaths (Fig. 144). The fall in mortality evidenced in the second decade

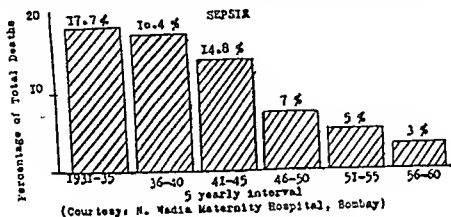


Fig. 144

marks the era of chemotherapy, and the beginning of the availability of penicillin. The remarkable fall noted in the last decade is attributable to antibiotics and to better aseptic and antiseptic measures.

Haemorrhages. A decadewise analysis reveals that, in the first decade, haemorrhages accounted for 12.6 per cent of the total deaths; in the second decade for 21.5 per cent of the total deaths, and in the last decade for 33.5 per cent of the total deaths. The rising percentage of deaths under haemorrhage is only apparent as deaths under sepsis and medical disorders have been considerably reduced (Fig. 145).

The detailed analysis of mortality from haemorrhagic complications shows that deaths from abruptio placentae have not fallen, deaths due to post-partum haemorrhage show a relative rise, whereas deaths due to placenta previa show a consistent fall (Fig. 146).

A critical analysis of deaths due to post-partum haemorrhage reveals that, it is assuming a relatively greater role in deaths due to haemorrhages. The employment of oxytocic drugs and blood transfusions have not materially altered the mortality from this cause.

The fall in the number of deaths from placenta praevia can be attributed to an increase in the use of caesarean section and blood transfusions.

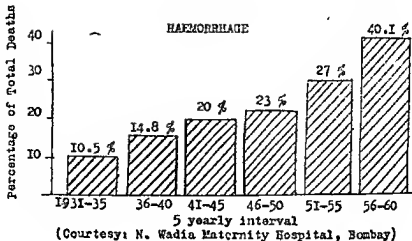


Fig. 145

The employment of the expectant line of treatment, a prominent feature in the management of placenta praevia in the leading countries of the world today, has not been availed of to the same extent in our country. The reasons for this are manifold, such as unavailability of sufficient number of beds in the antenatal wards, anaemia, and the reluctance on the part of the patient to undergo prolonged hospitalisation, which is an essential feature of this treatment.

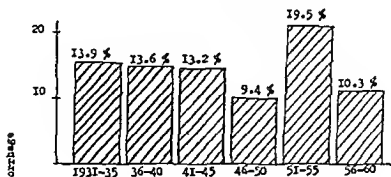
Medical Disorders. There has been a remarkable fall in mortality from medical disorders associated with pregnancy. The fall can be ascribed to better drugs available like antibiotics, better antimalarial measures, improved sanitation and greater consciousness on the part of the public of diseases enabling early diagnosis and treatment. Liaison between the medical and surgical colleagues of the K.E.M. Hospital and the Wadia Maternity Hospital, has also contributed largely towards this reduction (Fig. 147).

Operative Mortality. The number of destructive operations has consistently fallen, especially during the last decade, whereas the rate of caesarean section shows a constant rise due to its expanding indications (Fig. 148). The fall in operative mortality is due to better anaesthesia and free use of blood transfusions and antibiotics.

Pulmonary Embolism. It may be emphasised that pulmonary embolism as a cause of death in the post-operative period is rather uncommon in our country, probably because of the low incidence

COMPARATIVE MORTALITY OF VARIOUS TYPES OF HAEMORRHAGES

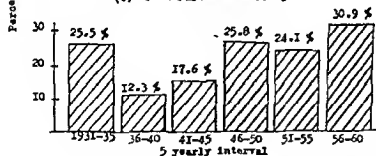
(A) Abruptio Placentae



(B) Placenta Praevia



(C) Post Partum Haemorrhage



(Courtesy: N. Wadia Maternity Hospital, Bombay)

Fig. 143

of thrombophlebitis and phlebothrombosis, attributed to the climatic conditions, and early ambulation on the part of our patients.

Conclusions

Avoidable Factors during Pregnancy. (1) The principal avoidable factor during pregnancy is failure to follow-up patients who do not attend the pre-natal clinic regularly.

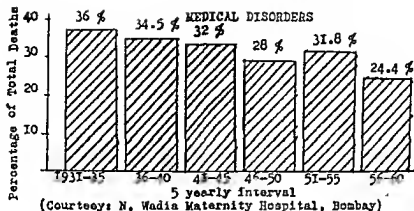


Fig. 147

GRAPH SHOWING INCREASED INCIDENCE OF CAESAREAN SECTIONS
AGAINST FALLING OPERATIVE MORTALITY

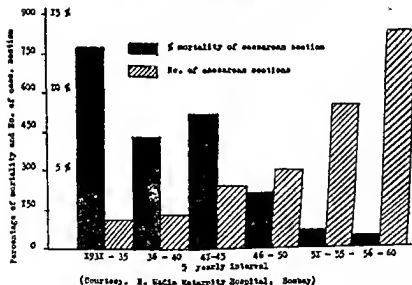


Fig. 148

(2) Inadequate antenatal care is also an important avoidable factor, particularly neglect to detect and treat anaemia. Failure to detect systemic diseases, such as cardiac lesions, diabetes, etc., are definite instances of inadequate antenatal care.

(3) Insufficient number of antenatal beds is also an important factor. Early admission of cases of toxæmia, hypertension and cardiac disease are instances where serious complications could have been avoided by prolonged hospitalization.

Not infrequently, patients refuse hospitalization and come later as emergency admissions.

Avoidable Factors during Labour. (1) Relegating responsibility to junior staff by the senior members on telephone conversation is undesirable. In some instances, junior staff undertaking operative deliveries without consulting the senior staff is the responsible factor.

(2) Bad management of the third stage of labour by labour ward nursing staff without realising in time the seriousness of the patient's condition is an important avoidable factor. This is particularly observed in cases of post-partum haemorrhage where there is a slow continuous leak of blood with an adherent placenta.

The gravity of manual removal of an adherent placenta in a patient in shock and circulatory collapse is, at times, not realised by the resident staff and death is directly due to it in some of these cases.

(3) Emergency admission after a prolonged or obstructed labour is frequent in India. Operative delivery in such neglected cases is a hazardous procedure.

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CHAPTER 2

PERINATAL MORTALITY

Crosse and Mackintosh introduced the term perinatal mortality in 1954. It is a composite term to include intrauterine deaths of the foetus during pregnancy, stillbirths and neonatal deaths during the first week of life. Although there has been considerable reduction in maternal mortality in most countries, yet perinatal mortality has not undergone a parallel reduction.

During the last 10 to 15 years, there has been a growing interest in the complete clinical and anatomico-pathological investigations of all perinatal deaths. As a result, the earlier classifications of perinatal mortality, based on clinical evidences only, have been superseded by clinico-pathological classifications. Routine post-mortem studies have given more direct information and better knowledge of the ultimate cause of death. As a result, there is greater awareness regarding the preventable factors and the responsibilities of obstetricians, paediatricians and others.

Perinatal mortality is influenced by many factors other than the availability of obstetric care and the efficiency with which it is given. Dougal-Baird and his associates in Aberdeen have focused upon the socio-economic factors. They have shown how perinatal mortality varies according to the social class from which the mothers come. In countries like India, where parity is high and reproduction rates unlimited by any form of family planning, perinatal mortality is necessarily higher than in those countries where a greater degree of family planning is practised.

In order to understand these changing trends, perinatal mortality is discussed in two separate sections. In the first section, the different groups of causes responsible for perinatal mortality are discussed. This will be followed by the discussion of various avoidable and unavoidable factors of perinatal mortality.

Incidence

United Nations Demographic Report (1959) for the countries of Europe, in addition to Canada, quoted by Nixon, shows wide variations in different countries. Stillbirths and neonatal deaths

per 1,000 viable births were lowest in Czechoslovakia, 23.8; while those for Portugal were highest, 58.7.

In India, accurate figures for perinatal mortality are not available and Menon rightly stresses that the figure of 46.3 per 1,000 births for the year 1960 should be accepted with reservation. More than 80 per cent of the population live in rural areas where the registration of births and deaths is very inaccurate and even in the cities and major towns the registration figures have an accuracy of about 90 per cent only.

Menon gives a perinatal death rate of 60.6 per 1,000 for the year 1960-61 in the city of Madras. Naidu gives a rate of 51.7 per 1,000 for the year 1960-1961. At the Nowrosjee Wadia Maternity Hospital the rate for the year 1961 was 63.2.

Section I

Foetal death may occur (1) before the onset of labour, (2) during labour, or (3) during the first week of life.

Foetal Deaths before Onset of Labour

These deaths fall into two clinico-pathological groups: (1) antepartum deaths with maceration, and (2) as a result of antepartum asphyxia. Nixon states that 25% of all perinatal deaths occur before labour.

Foetal Death with Maceration. The foetus after its death may be retained in utero for as long as 3-4 weeks and shows advanced maceration. The death of the foetus is usually due to gradual placental insufficiency. The associated maternal clinical complications responsible for intrauterine death are: (1) severe toxæmia, (2) repeated small antepartum haemorrhages, (3) diabetes, (4) multiple pregnancy, (5) Rhesus or other blood group incompatibility, (6) syphilis, and (7) high maternal age. Apart from maceration, the naked eye and histological examinations of the different organs do not reveal any disease of the foetus.

Antepartum Asphyxia. In this group also death occurs before the onset of labour, but, in contrast to the previous group where gradual placental insufficiency is responsible, the cause of death in antepartum asphyxia is sudden deprivation of oxygen supply to the foetus. The associated maternal clinical conditions responsible for foetal deaths are: (1) severe toxæmia with abruptio pla-

centae, (2) a severe bout of bleeding in placenta praevia, (3) premature separation of placenta following external version, and (4) strangulation by two or more loops of cord round the neck.

On post-mortem examination, there are evidences of asphyxia, as petechial haemorrhages or ecchymoses on the surface of the lungs, and massive inhalation of amniotic contents.

Foetal Deaths During Labour

These deaths are due to: (1) intrapartum asphyxia, (2) stress of labour, and (3) respiratory distress syndrome.

Intrapartum Asphyxia. Sudden deprivation of oxygen to the foetus during labour occurs from, (1) prolapse of cord, (2) abruptio placentae or intrapartum bleeding in placenta praevia, (3) post-maturity, that is prolongation of pregnancy beyond 42 weeks, (4) labour prolonged for more than 24 hours, and (5) breech delivery. Nixon states that the risk of intrapartum death in uncomplicated labour is at least five times greater in the presence of hypertension or prolonged pregnancy.

On post-mortem examination, there is evidence of asphyxia without any evidence of intracranial birth trauma.

Trauma or Stress of Labour. Trauma and stress of labour take a heavy toll in both mature and premature infants. The conditions during labour which predispose the infant to trauma are, (1) trial labour in cephalopelvic disproportion, (2) abnormal uterine action (3) breech delivery and breech extraction, (4) difficult mid-cavity forceps, and (5) malpresentations.

Except in an occasional case, intracranial haemorrhage with damage to the intracranial structures or to the skull is found during post-mortem examination and is responsible for foetal death. The nature of intracranial haemorrhage is fully described under "intracranial haemorrhage."

Respiratory Distress Syndromes. They are, (1) hyaline membrane, (2) massive intra-alveolar haemorrhage, and (3) pulmonary oedema. These three occur either singly or in combination.

Pulmonary syndrome commonly occurs in premature births. It is also a frequent association with caesarean section. Apart from these two clinical conditions, the cause and pathogenesis remain obscure.

On post-mortem examination, the lungs are voluminous and dark purple in colour. The cut surface of the lungs is dark and

solid resembling foetal liver. Histologically, hyaline membrane is found lining the alveoli, particularly the terminal alveoli. Alveolar haemorrhage may be limited, patchy or massive and involving the whole lung. The effused red cells are usually well preserved.

Neonatal Deaths

The five main causes of neonatal deaths are (1) prematurity, (2) congenital malformations, (3) effects of intrapartum birth trauma or asphyxia, (4) respiratory distress syndrome, (5) massive intraventricular or pulmonary haemorrhage, and (6) pneumonia.

Congenital Malformations. Major congenital malformations, apparent at birth, are anencephaly and hydrocephaly. Anencephaly is the most frequent malformation. Other occult malformations, as diaphragmatic hernia, are detected by post-mortem examination. Nixon states that major congenital malformations accounted for 1 in 6 of all neonatal deaths. Naidu found the incidence in her series to be 6.3 per cent.

Pneumonia. Preponderance of pneumonia is met with in neonates over 2,500 gms. When death occurs within 24 hours of birth, the infection is usually acquired before or during birth as a result of inhalation of amniotic contents.

Neonatal death, some days after birth, is usually due to pulmonary infection acquired after birth. It is more prone to occur in neonates born with low vitality as a result of foetal distress and complicated vaginal deliveries.

Section II

Perinatal mortality, in socio-economically advanced countries, has shown reduction in the last twenty years, but much still remains to be done to reduce its incidence. In an economically undeveloped country like India, the rate is still very high. A perinatal survey, conducted in Britain in 1958 with the support of the National Birthday Trust Fund, is revealing. In spite of a good standard of obstetric care in the light of the present day knowledge, 1 in 28 mothers leaving a maternity hospital in Britain leave without a live baby. It shows that, besides improved obstetric and paediatric care, socio-economic problems play an important part. If this is the state of affairs in an economically advanced country

like Britain, the conditions prevailing in an economically under-developed country like India must be considerably worse. Investigations on perinatal mortality in India are limited to one or two large maternity institutions of a city or large town and do not in any way reflect the real problem of India as a whole. As already stated, more than 80 per cent of the population live in rural areas where obstetric care is either totally unavailable or is very inadequate and perinatal mortality must be appallingly high.

Socio-economic Problems. Dugald Baird and his team have found that perinatal mortality varies according to the social class from which the mothers come. Camacho stresses this point by giving the figures of perinatal mortality in a free hospital as 84.9 and in another hospital admitting a better socio-economic group of mothers as 43.9. Peel gives figures for Great Britain in the industrial areas as 44-46 per 1,000 and in South-East England as 32-34 per 1,000. Comparative figures from India are not available.

In the lower socio-economic classes of the population with all its implications of poverty, malnutrition, inadequate obstetric care, and medical and intrinsic complications of pregnancy, perinatal mortality is high. One additional factor prevailing in the free obstetric institutions of India is that the mothers are discharged from the hospital between the third and the fifth post-natal days and this exposes the newborn to unfavourable home surroundings.

Obstetric Problems. Recent advances in obstetrics have definitely reduced perinatal mortality. It should be appreciated that not all the known causes of perinatal mortality are avoidable by good obstetric management. Prematurity still claims a high toll. A brief review of the various obstetric causes and how far they can be prevented is given below.

Prematurity. It is generally estimated that in nearly 50 per cent of the cases of premature birth, no definite cause can be discovered. It is always difficult to define what constitutes a premature baby. Prematurity can be defined according to the birth weight or to the estimated weeks of gestation. According to Peel, 60 per cent of all perinatal deaths occur in premature infants. Sugai et al give a figure of 66 per cent from Japan. Menon gives the incidence of prematurity among perinatal deaths as 71.2 per cent.

The known causes of premature births are, pre-eclampsia, twin pregnancy, hydramnios, antepartum haemorrhage and severe anaemia. The prevention of toxæmia by good antenatal care, vigorous treatment of pre-eclampsia, expectant line of treatment in cases

of placenta praevia, abdominal paracentesis in cases of hydramnios to prevent premature labour are measures which contribute to a certain measure towards preventing prematurity.

The remedy for unknown causes of prematurity lies in the general improvement in the standard of living. The care of premature infants by experienced paediatricians with a trained nursing staff in a separate ward is of great value in reducing perinatal mortality.

Post-maturity. Perinatal mortality in pregnancies prolonged for more than 42 weeks is estimated to be three times higher than the one in pregnancies ending delivery between 38 to 42 weeks. Intrauterine death in post-mature pregnancies does occur but the incidence is much less as compared to intrapartum deaths. The stress of labour is the most important factor causing foetal distress and death in postmature foetuses. Therefore, routine induction at 42 weeks' term is a necessary measure. During labour, a good prophylaxis is to rupture the membranes when the cervix is half dilated in order to detect the presence of meconium and in order to hasten labour. If the dilatation of the cervix is tardy, or there is inco-ordinate uterine action, or signs of beginning foetal distress occur, a caesarean section is the best mode of delivery in post-mature cases.

Age and Parity. The perinatal mortality is high in mothers below 20, is lowest between 20 and 25, and rises sharply in the age group 30 to 40.

It is highest in the first pregnancy, is least in the second to fourth parae, and increases steadily thereafter.

In India, women above the age of 30 are usually grand multiparae in whom malpresentations causing obstructed labour occur more frequently. Also, the frequency of toxæmia is higher in women of age group 30 to 40.

Antepartum Haemorrhage. In the severe types of abruptio placentae, toxæmia is an associated complication in the majority of cases and the foetal loss is almost 100 per cent. The incidence of toxæmia in the milder varieties of abruptio placentae is roughly 20 per cent and the foetal loss is about 10 to 15 per cent. Adequate antenatal supervision to prevent and promptly treat toxæmia is a useful preventive measure.

The foetal loss due to prematurity in placenta praevia has been reduced during the last 15 years as a result of the introduction of expectant treatment, but in India, due to lack of hospital accommodation, poverty and ignorance, the scope of expectant treat-

ment is limited. Twenty-five years ago, foetal loss during vaginal delivery of cases of placenta praevia was 60 to 70 per cent. The routine use of caesarean section for types 3 and 4, and more frequent use in types 1 and 2, has considerably reduced foetal loss which is now about 30 per cent.

Maternal Diseases. The most prevalent diseases are malaria, anaemia, infective hepatitis, diarrhoea and dysenteries. The control of malaria in recent years has greatly reduced foetal loss from this cause.

Severe nutritional anaemia is still largely prevalent and premature labour is very common in these cases. Many of them come for treatment late in pregnancy and spontaneous premature labour is unavoidable. Premature labour is, at times, precipitated by parenteral iron therapy or by blood transfusions. It is a national problem and obstetrical care by itself cannot achieve much.

Diarrhoea, dysenteries, small pox, and other virus diseases are prevalent in India. They are related more to socio-economic factors than medical care.

The role of syphilis in present day obstetrics is difficult to estimate in India. Routine serological examinations are undertaken in most prenatal clinics but, in rural areas, where prenatal care is either non-existent or inadequate, foetal loss from syphilis must be considerable.

Toxaemia. Premature labour frequently occurs in pregnancies complicated by toxaemia. Abruption placentae is also a cause of foetal wastage in these cases. Intrauterine death of the foetus in toxaemia occurs and is due to placental insufficiency.

Birth Trauma. Twenty years ago, perinatal mortality due to stress of labour and birth trauma was considerable. The more frequent use of caesarean section in complicated labour has replaced such difficult and disastrous vaginal operations, as high forceps, breech extractions and versions. A properly conducted trial and timely caesarean section in cephalo-pelvic disproportion have reduced perinatal loss.

The wastage from perinatal mortality will be substantially reduced in India only when the standard of living of the population is raised and organised obstetrical care is made available to all the rural areas. Some of the urgent needs are linking of spread-out villages by good roads to one another and to nearby towns, readily available trained nursing and medical personnel, and family planning.

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CHAPTER 3

USES OF OXYTOCICS IN OBSTETRICS

The oxytocic effect of posterior pituitary extract was described by Dale in 1906. Blair Bell, also in 1906, first reported the use of posterior pituitary extract in obstetric practice. This extract contained both oxytocic and vasopressure fractions of the posterior pituitary gland. The two fractions were later isolated by Kamn and his co-workers. It was given intramuscularly in fractional doses of 2 units every half an hour. Intramuscular use of pitocin was not without danger to the mother and the foetus. The oxytocic principle was marketed by Parke Davis & Co. under the name 'pitocin'. In 1953, Du Vigneud et al synthesised a substance having the hormonal activity of oxytocin for which Du Vigneud was awarded the Nobel Prize for 1955. In recent years, another organic compound, sparteine sulphate, is employed intramuscularly as an oxytocin.

A notable advance in oxytocic therapy was the administration of oxytocin intravenously in drip form. It was first employed by Theobald in 1948 for induction of labour. Since then oxytocin drip has been successfully used in several other obstetric conditions.

Intramuscular Therapy

Since the introduction of intravenous oxytocin drip, the indications for intramuscular therapy have been greatly reduced. At the present time, pitocin or the synthetic preparation, syntocinon, is chiefly used for the following indications: (1) To contract the uterus during caesarean section; 5 units are injected either directly into the uterine muscle or intramuscularly into the arm. Direct injection into the uterine muscle is practised only as a matter of convenience and has no particular advantage over intramuscular injection in any other muscle because oxytocin has first to enter the circulation before it can contract the uterus. (2) For post partum haemorrhage after a vaginal delivery, 5 units are given intramuscularly for quick action on the uterus.

Sparteine Sulphate

Pure sparteine is a naturally occurring organic compound re-

lated to the group of alkaloids known as lupanine bases. For clinical use, the crystalline salt, sparteine sulphate, is used. Sparteine sulphate has been used clinically in the treatment of cardiac irregularities since 1873. Within the last twenty years, several reports on the oxytocic action of sprateine sulphate have appeared in European and South American literatures. An extensive study by Plentl, Friedman and Gray on the use of sparteine sulphate in 1364 intra-partum and 200 post partum patients has been reported in 1961. In India, Devi from Nagpur has reported the results in 42 cases. It is under trial at N.W.M. Hospital, Bombay.

The action of sparteine sulphate on the pregnant uterus is like that of other oxytocics used at present in obstetrics. The great advantage of sparteine sulphate over the present oxytocins used in intravenous drip form is that it can be given intramuscularly. At the same time intramuscular route has the disadvantage that once given there is no control over the action, while intravenous oxytocin drip can be regulated according to its action on the parturient uterus. It should be stressed that supervision of the patient receiving sparteine should be as close as when intravenous oxytocin drip is employed because the same dangers inherent in the use of oxytocins in labour pertain to sparteine sulphate also.

The dose of sparteine sulphate employed varies according to the response of the uterus. Devi gave four doses of 100 mg. each, at one hourly interval, in most of her cases. If the uterus fails to respond after the four doses of sparteine sulphate, it should be discontinued and intravenous oxytocin drip substituted.

Indications. *Hypotonic Uterine Inertia.* Sparteine is most successfully used in cases of hypotonic uterine inertia. The rhythm of the contractions is regulated and the force is increased. In 10 cases in which it was used by Devi, the dose ranged between 150 to 600 mg. and the results were excellent in all the cases. Other reports also find sparteine useful in toning up a hypotonic uterus.

Induction of Labour. Sparteine is successful in inducing labour in approximately 50 per cent of the cases. Labour was successfully induced in 7 out of 15 cases reported by Devi. The percentage of success is proportional to the term of pregnancy. Sparteine usually succeeds in inducing labour near term. It frequently fails to induce labour when pregnancy is of less than 36 weeks' duration.

Premature Rupture of Membranes. When spontaneous labour pains do not commence for more than 12 hours after premature

rupture of membranes, sparteine is usefully employed to start labour pains.

Immediate Post-partum Period. It has been injected directly into the myometrium at caesarean section and the response has been good. However, sufficient trial has not been reported in the management of postpartum haemorrhage.

The drug needs extensive clinical trials for definite evaluation of the indications. Considering the ease of administration, it is very likely to prove a useful oxytocic drug in the immediate future.

Intravenous Oxytocin Therapy

Indications. Abortion. Oxytocin drip is usefully employed for evacuating products of conception in cases of inevitable and missed abortion. In inevitable abortion, oxytocin drip is particularly useful when the uterus is enlarged to more than 10 weeks' size.

Missed Abortion. The uterus, being inactive, does not respond to the usual dose of 5 units of oxytocin to a pint of 5 per cent dextrose solution. Massive doses of oxytocin are required before the uterus begins to contract. As much as a total of 100 or more units may be necessary.

Vesicular Mole. With a vesicular mole, the uterus is usually enlarged to a size of 20-24 weeks, and considerable blood loss occurs during digital evacuation. Spontaneous evacuation of the entire or the major portion of the mole by oxytocin drip can be rightly considered as of definite help in these cases.

When slight vaginal bleeding has commenced and the cervix has dilated the uterus is already sensitized and responds very well to oxytocin drip. In the series of 93 cases of vesicular mole reported by Daphtary and Masani from N.W.M. Hospital, the cervix was open in 46 cases. An oxytocic drip was started and spontaneous evacuation of the mole occurred in all the cases.

In 28 more cases, the cervix was closed and laminaria tents were inserted. The next day oxytocin drip was started after removing the tents. Spontaneous evacuation of the mole occurred and the process was completed either digitally or by light curettage.

Thus oxytocin drip was employed in more than three-fourths of the cases.

Induction of Labour. With recent advances in obstetric management many of the previous indications for inducing labour before term, in the interests of the mother or the foetus, have been

outdated. Systemic diseases, like cardiac and pulmonary diseases and diabetes mellitus, are now better managed by the co-ordinated efforts of the physician and the obstetrician. Only a few cases of essential hypertension or renal disease need induction of labour. Though post maturity is difficult to define, clinically, a pregnancy that has been prolonged to 42 weeks and beyond is considered as postmature, and induction of labour by oxytocin drip is advisedly carried out.

An oxytocin drip containing 1 unit in a pint of 5 per cent dextrose solution is run in at the rate of 40 drops a minute. If this fails to initiate uterine contractions, 2.5 units of oxytocin are added to the next drip. When the cervix is not ripe, it may be necessary to give several pints of the drip before labour pains commence.

Inco-ordinate Uterine Action. (1) In hypotonic uterine inertia, oxytocin drip gives satisfactory results. The number of abdominal sections and difficult forceps deliveries has been substantially reduced as a result of the introduction of oxytocin drip in obstetric practice. A drip of 5 per cent dextrose solution containing only 2.5 units of oxytocin is sufficient to increase the force of uterine contractions and shorten the first stage. The drip should be continued in the second stage also. Oxytocin drip, not only hastens dilatation of the cervix in these cases, but also effects the gradual descent and internal rotation of the head. Occipito-transverse or occipito-posterior positions are frequently associated with hypotonic uterine action and oxytocin drip aids rotation of the head and increases the chances of spontaneous vaginal delivery. Even those who do not deliver spontaneously are easily delivered by forceps after spontaneous rotation of the head.

Hypertonic Uterine Action. In these cases, oxytocin drip is contraindicated as it tends to exaggerate the abnormal activity. The best form of treatment is to keep the patient sedated by giving adequate doses of pethidine and chlorpromazine group of drugs. Later, when regular uterine action is established, oxytocin drip may be employed to hasten labour.

Placenta Praevia. Oxytocic drip is sometimes usefully employed in type 1 and type 2 placenta praevia. When uterine action is adequate during labour, rupture of the membranes is sufficient to arrest bleeding by compression of the placental site by the presenting part. In those cases where uterine action is feeble, the presenting part does not come down sufficiently after the rupture of the membranes to compress the placenta and, in these cases, an

oxytocin drip is useful in increasing the force of the uterine contractions. Formerly, compression of the placental site was brought about in these cases by traction on the scalp by a Willett's forceps or by pulling down a leg.

Accidental Haemorrhage. Oxytocin drip is usefully employed in both, revealed and concealed, varieties. Oxytocic drip should never be given prior to the rupture of the membranes, as the rise in the intra-amniotic pressure caused by oxytocin is likely to squeeze thromboplastin from the retroplacental clot into the circulation, and lead to hypofibrinogenaemia.

Revealed or Mixed Type. As the uterus is active in these cases, rupture of the membranes is usually sufficient to increase the force of uterine contractions, but there are cases in which a drip containing 5 units of oxytocin to a pint of 5 per cent dextrose solution is necessary to hasten labour.

Concealed Type. Formerly, concealed accidental haemorrhages was a formidable obstetric problem, but oxytocin drip has considerably improved the outlook. Formerly, a wait and watch policy was adopted and those who did not go into spontaneous labour following treatment of shock were submitted to abdominal section. At the present time, immediately after instituting treatment of shock, the membranes are ruptured and an oxytocin drip is started. As the uterus is totally inactive, the usual dose of 5 units is insufficient. Initially, 10-15 units are added to a pint of 5 per cent dextrose solution and, frequently, the dose of oxytocin needs to be increased to 30 units by the further addition of oxytocin to the drip.

Postpartum Use of Oxytocin Drip. In atonic postpartum haemorrhage or when manual removal of placenta is resorted to, a drip of 5 per cent dextrose solution containing 5, or even 10, units of oxytocin is run in to maintain the uterus in a contracted and retracted state.

Action and Uses of Ergot

Ergot is a parasitic fungus (*Claviceps purpurea*) which grows on rye and, occasionally, on other kinds of grains. The specific action of ergot upon the uterine muscle has been known for centuries, and crude preparations of ergot have been used by midwives as oxytocics.

There are six isomeric pairs of natural alkaloids of ergot. The

most important of these are ergometrine (ergonovine), ergotamine and ergotamine. Stoll has prepared several synthetic alkaloids of the ergot types. Of these, the combination of lysergic acid and hydroxyl butylamide (methergine) has marked oxytocic activity. The action of methergine is as rapid as ergometrine but surpasses it in the intensity and character of its effect.

It should be noted that the powerful action of ergot alkaloids is specifically on the smooth muscle of the uterus, and the smooth muscles of other viscera are not affected to any significant extent.

Ergometrine increases the tone, rate and amplitude of rhythmic uterine contractions. The effect of ergot on the uterine muscle is particularly marked on the parturient uterus.

Ergometrine maleate is given orally as a solution or as tablets in 1 mg. dose and its action on the uterus is manifest in about 8 minutes. For Intramuscular injection, 0.5 mg. is used and it acts in about 4 minutes. By intravenous injection, vigorous contraction of the uterus follows within one minute. The dose is 0.25 mg.

Indications. (1) *Primary Uterine Inertia.* Ergometrine is contraindicated during the first and second stages of labour as even small doses may produce tetanic contractions with disastrous results. Gill and Farrar reported, in 1957, their experiences of dihydro-ergotamine, a synthetic preparation, in 43 cases of primary uterine inertia and claimed beneficial results in 34 cases. In spite of these successful results, synthetic or natural derivatives of ergot are contraindicated during the first and second stages of labour.

(2) *Prior to Digital Evacuation of Uterus.* Whenever digital evacuation for vesicular mole or inevitable abortion is necessary, an intramuscular injection of 0.5 mg. of ergometrine is preferably given to produce a sustained contraction of the uterus. It not only reduces the blood loss but also minimises the danger of perforation of the enlarged soft uterus.

(3) *To Reduce Blood Loss and Duration of Third Stage.* It has become a routine with most obstetricians to give 0.25 mg. of ergometrine intravenously or 0.5 mg. intramuscularly immediately after the head is born. There is convincing evidence that the amount of blood loss and the duration of the third stage is definitely reduced by this prophylactic measure. The author in 1955 compared the results of 100 cases of normal labour treated by prophylactic intramuscular injection of ergometrine with 100 control cases. In the series without ergometrine, the blood loss was upto 5 ounces in 59 cases and upto 10 ounces in 94 cases. In the series with

ergometrine, blood loss was upto 5 ounces in 80 cases and upto 10 ounces in 98 cases.

Postpartum Haemorrhage. Postpartum bleeding is the most important indication for the use of ergometrine. When atonic bleeding occurs after the expulsion of the placenta, 0.25 mg. of ergometrine is given intravenously. If the intramuscular route is preferred, 0.5 mg. is injected.

When bleeding commences while the placenta is still within the uterine cavity, manual removal of the placenta is preferable to injection of ergometrine. Ergometrine sometimes produces annular constriction of the lower part of the uterus and, though the placenta may separate following injection of ergometrine, it will be retained above the annular constriction. Once the placenta is manually removed, ergometrine should be given to maintain prolonged contraction and retraction of the uterus.

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CHAPTER 4

POSTMATURITY

The term postmaturity refers to a condition in which pregnancy is unduly prolonged beyond term. The chief factor for increased perinatal mortality in these cases is foetal anoxia resulting from placental insufficiency. The foetus may die in utero before the onset of labour, and is born maccrated; but, more frequently, the foetal distress, as a result of anoxia, occurs during labour, and, if severe enough, the foetus may be stillborn. A post-mortem examination of such a foetus is inconclusive, and such deaths are unexplained.

The biggest problem is to differentiate a mere prolongation of pregnancy from postmaturity. Neither clinical observations nor radiological evidence affords any clue to the diagnosis of postmaturity. Even clinical appearance of the infant after birth is not conclusive. Examination of the placenta does not show any specific changes. Clinical observations during pregnancy are so variable as to be of not more than relative value in the diagnosis of postmaturity.

The prolongation of pregnancy is really a prolongation of the fertilisation-delivery interval, but menstruation-delivery interval is the only figure that is available for use in practice. The practical difficulty is to know the precise date of ovulation and fertilisation and, in practice, this knowledge is seldom available. Only in those cases where artificial insemination has been done or only one coitus has taken place during the menstrual cycle, is it possible to calculate the fertilization-delivery period. In all other cases, menstruation-delivery interval by Naegele's rule of adding seven days and nine calendar months is the only available data to arrive at the expected date. In calculating the date of expected delivery, the regularity and duration of the menstrual cycle are important.

The height of fundus, the size of the foetus by palpation, and the date of quickening are not reliable. A deeply engaged head well applied to a thinned lower segment and a ripe cervix suggest, at least, a mature foetus.

The radiographic appearance of the centres of ossification, and the degree of ossification of the skull are also of relative value. The

ossification centre of the cuboid usually appears at term, and its appearance denotes probable maturity, but not necessarily post-maturity.

Effects of Postmaturity on Placenta. Degenerative changes take place in the placenta as it ages. There is diminution of chorionic epithelium, the formation of endarteritis of the vessels within the villi, and increasing calcification, as the placenta becomes older.

Transfer of oxygen to the foetus falls gradually as term approaches, and falls very rapidly after term. This suggests that although a post-mature foetus may have enough oxygen for its resting stage or for a short labour, it has little or no reserve for withstanding the stresses of a long or difficult labour.

Effect of Postmaturity on Foetus. Statistical data reveal that perinatal mortality is greater in postmature cases, and that the more prolonged the pregnancy after forty weeks, the greater is the still-birth rate. Investigations show that there is a gradual fall in the oxygen content and oxygen saturation as term approaches. The oxygen saturation which at term is 60 per cent, gradually falls until a critical level of 30 per cent is reached when pregnancy is prolonged to 43 weeks. From this it suggests that the foetus strives to maintain its oxygen supply by increase in the foetal haemoglobin level and the red cell count. Should labour be easy and spontaneous, foetal distress does not occur, but foetal distress from anoxia is very likely when labour is prolonged or difficult. The only clinical manifestation of deficient oxygen supply is the passage of meconium and the slowing of the foetal heart rate.

Management. The clinical picture of postmaturity is seldom clear cut, and therefore the management of each case must be considered on its merits. However, from clinical experience and experimental data it is evident that the danger to the foetus from anoxia is not great until pregnancy has been prolonged beyond forty-two weeks, and active treatment until then is not required. Again, most of the cases by this time go into labour.

When pregnancy is prolonged beyond forty-two weeks, medical induction, by giving two ounces of castor oil followed by an enema two hours later, is advisably done. If the cervix is 'ripe' one can confidently expect labour to commence following this simple treatment.

Medical Induction Combined with Pitocin Drip. Admittedly, uterine contractions following pitocin drip reduce still further the oxygen supply to the foetus, but there is no danger in using pito-

cin drip to induce labour when pregnancy is prolonged beyond forty-two weeks. Once labour pains at regular ten minutes' intervals set in, pitocin drip is discontinued so as to avoid precipitating foetal distress from prolonged anoxia.

Induction of Labour by Rupture of Membranes. Unless the cervix is "taken up" and admits a finger, it is inadvisable to rupture the membranes. A long cervix itself indicates that probably pregnancy has not yet reached term, and the hazards to the possibly premature foetus, both during labour and after birth, may prove to be of greater disadvantage than postponing induction. Unless the head is engaged, rupture of membranes carries the possible risk of prolapse of the cord. The advantage of rupturing the 'hind' waters is that it gives an indirect opportunity of assessing the state of the foetus by noting the presence or absence of meconium in the liquor amnii. The presence of meconium indicates that there is a deficient supply of oxygen to the foetus.

Elective Caesarean Section. When pregnancy is prolonged beyond forty-three weeks, delivery by caesarean section should be seriously reviewed. The oxygen supply by this time is just sufficient to keep the foetus alive in utero, and chances of stillbirth from further unavoidable reduction of oxygen supply during labour are considerable. In the case of an elderly primipara, or when there is a malpresentation of the foetus, or when there is clinical evidence of cephalo-pelvic disproportion, elective caesarean section is the treatment of choice.

CHAPTER 5

RADIOLOGY IN OBSTETRICS

Radiological aid in diagnostic problems in obstetrics is invaluable. However, it must be remembered that it is a supplement to and not a substitute for proper clinical evaluation. It should be used to obtain information unavailable by any other means. Injudicious use of radiology is not without harm. Radiation to the foetus in its early weeks may disturb its growth and, as far as possible, all radiological studies of the abdomen should be avoided during the first five months of pregnancy. As suggested by Stewart et al, there is also a fear that radiation received in utero increases the possibility of the newborn developing neoplastic disease in childhood. Due to the fall-out from nuclear explosions our attention is being acutely focussed on the possible genetic damage caused by x-rays by deranging chromosomal patterns in the maternal and foetal gonads and increasing gene mutation rate. According to Parlee, 80r to the gonads seems to be the dose that would double the gene mutation rate and hence should be considered alarming. Other estimates of this dose are as low as 30r or even less. Radiation reaching the maternal ovaries even during the multiple exposures required for pelvimetry is 1 to 3r. Foetal gonads receive a much smaller dose except in breech presentation or in inlet views. Diagnostic radiological procedures during pregnancy thus do not appear dangerous. Yet, as Berman and Sonnenblick say, all ionizing radiation, no matter how small the dose, is potentially hazardous genetically due to its cumulative effects. Hence an x-ray examination should never be undertaken without sound indications. Non-obstetric diagnostic radiology, like intravenous pyelography, should, if possible, be avoided during pregnancy to spare the foetal gonads. Besides, the amount of radiation during any radiological investigation should be reduced to the minimum by various means like added filtration, higher kv, faster films, minimum number of films, reduction in the size of the field exposed and, last but not the least, elimination of re-takes by meticulous attention to technical details. It must be emphasized, however, that properly indicated diagnostic radiology should be undertaken without any hesitation. The following are some of the conditions which might need radiological aid.

Foetal Abnormalities

Foetal malformations may be accidentally detected at radiological examination undertaken for other purposes. In cases of hydramnios, it is better to exclude foetal abnormalities to avoid the fruitless continuation of the pregnancy made so uncomfortable by the abnormal distention of the uterus. It is also a sound practice to rule out an abnormal foetus by radiological examination before undertaking a caesarean section. Advance knowledge of foetal abnormality may alter the management of the case. It must be emphasised that foetal abnormalities can very easily be overlooked in the x-ray picture unless a systematic study of the foetal skeleton is always done as a routine practice. Hydrocephalus may be obvious by the large size of the head, characteristic forward bulging of the brow and the abnormally wide suture lines. However, in a breech presentation, the diagnosis of hydrocephalus should never be made from an anteroposterior plate because the head, being much closer to the x-ray tube than the rest of the foetus, appears magnified out of proportion. This fallacy can be avoided by obtaining either a lateral or a postero-anterior picture. Anencephaly can usually be made out easily by the absence of the vault of the skull (Plate 138). Interruption of the normal curved contour of the foetal spine should arouse the suspicion of spina bifida. Foetal ascitis and hydrothorax may be indicated by the splaying of the ribs and the disturbance of the flexed attitude of the spine and the limbs, the latter diverging away from the trunk. This leads to the foetus assuming a "Buddha" position.

Foetal Death

The suspicion of foetal death aroused by the absence of uterine growth, foetal heart sounds and foetal movements may be confirmed radiologically by noting Spalding's sign, extreme hyperflexion or angulation of the spine, the collapse of the thoracic cage and free gas in the foetal vessels. Spalding's sign consists of overlapping of the skull bones at the sutures (Plate 139). As this is due to the shrinkage of the brain, it is not seen until a few days have elapsed after foetal death. Moulding of the head should not be confused with Spalding's sign. Besides the fact, that moulding is never seen at the frontal suture, in moulding, overlapping of the bones is regular with the frontal and occipital bones depressed

under the parietal bones whereas overlapping of the bones is irregular after foetal death. When in doubt, the radiograph should be repeated after a few days and, besides other signs, this will show that the foetal position is unaltered. A live foetus moves about and is not likely to be seen in the same position on radiographs taken at intervals of a few days. Free gas (nitrogen) in the heart and blood vessels of the foetus is demonstrable as early as 24 hours after foetal death.

Diagnosis of Pregnancy

Although foetal bones can occasionally be seen as early as 14 weeks, the diagnosis of pregnancy by x-ray examination is usually possible only after 16 weeks. Small foetal bones may be invisible against the dense shadows of the maternal bones of the lumbosacral area. Therefore, it is better to get an inlet view by placing the patient on an inclined plane of 25 to 30 degrees, or by using the semisitting position. As an alternative, the tube may be angled 25 to 30 degrees towards the foot end of the table, or the patient may be positioned obliquely to displace the sacrum from the centre of the pelvis. Although the presence of foetal shadow gives a positive diagnosis of pregnancy, its absence does not rule out pregnancy in the early months. Radiological examination is of help in differentiating pregnancy from pelvic tumours or from vesicular mole. Because of possible harmful effects of radiation on the early embryo it is desirable to avoid radiological examination whenever possible.

Multiple Pregnancy

When the diagnosis of multiple pregnancy is clinically doubtful, it can be confirmed or ruled out by radiological examination. Besides showing the number of foetuses, the radiological picture also gives their presentation (Plates 140 and 141). However, there are fallacies in the radiological diagnosis of multiple pregnancy. These may be the result of faulty technique, use of films not large enough to include the whole of the abdomen, foetal movements during exposure, superimposition of the foetal shadows, and poor foetal shadows due to the small size of the foetuses or associated hydramnios. Conjoined twins may be accidentally diagnosed radiologically by finding: (1) the two heads at the same level, (2) the

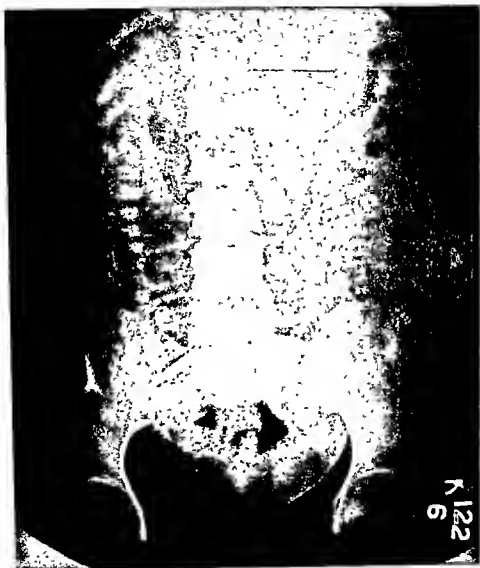


Pl-138. Anencephalic monster with ascitis and hydrothorax (p. 655)

h. 1



Pl-139. Intrauterine foetal death. (p. 655).



Pl-140. Twin pregnancy; first foetus presenting by vertex and second by breech. (p. 646).



Pl-141 Twin pregnancy; first foetus presenting by breech and second lying transverse. (p. 656).



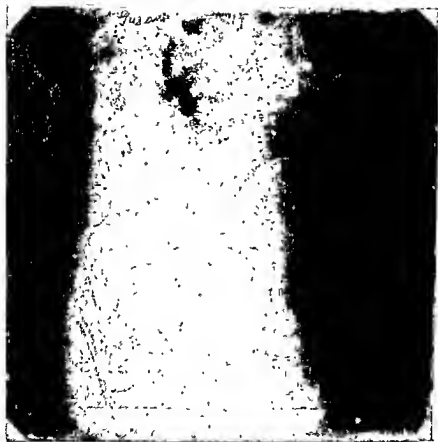
Pl-142. Breech with extended legs. (p. 657).



Pl-143. Transverse lie, thorax presenting. (p. 557).



Pl-144. Cystography. Lateral X-ray in a case of anterior placenta praevia.
(p. 658).



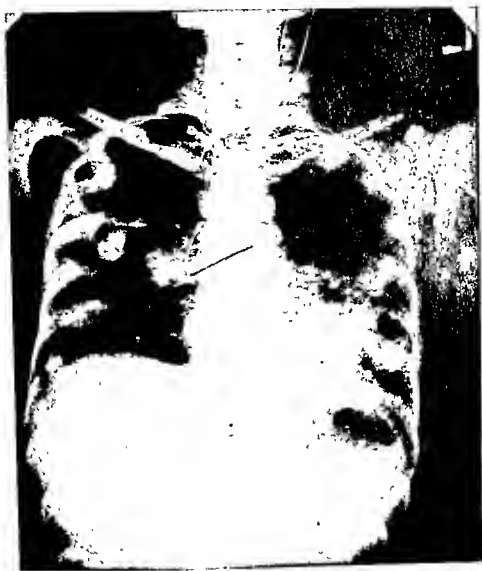
Pl-145. Lateral X-ray showing anterior displacement of the head due to posterior placenta praevia. (p. 659).



PI-146. Osteomalacic pelvis with multiple fractures. (p 659)



Pl-147 Lateral X-ray taken during labour showing moulding and engagement of the head. (p. 660).



Pl-148. Secondary deposits from choriocarcinoma in the lungs. (p. 663)

shoulders at the same level, (3) the spines close to and parallel to each other and (4) the foetuses staring at each other in some cases of thoracopagus.

Presentation and Position

Diagnosis of presentation and position may be clinically difficult or, occasionally, even impossible if the patient has a large abdomen, if she is obese, if the uterus is tense, or if she is uncooperative. Even a vaginal examination may be inadequate for diagnosing presentation and position if the patient is in early labour and the bag of waters tense. An x-ray examination may be required in such occasional cases for excluding an abnormal presentation. Abdominal palpation in a primigravida having breech with extended legs is often inconclusive and the diagnosis may have to be made radiologically (Plates 142 and 143).

Estimation of Foetal Maturity

The assessment of maturity of the foetus is important in clinical obstetrics when an induction of labour or an elective caesarean section is contemplated or when the possibility of postmaturity arises. Apart from the fallacies associated with the estimation of foetal maturity from the date of the last menstrual period, the latter is often not obtainable from the patients attending the antenatal departments of our hospitals. Calculation of the maturity from the fundal height is neither accurate nor always reliable. One naturally looks to radiology when faced with the problem of foetal maturity. The x-ray picture must be of good quality for the estimation of maturity, which is based on the appearance of the ossification centres and the measurements of the foetal head. The ossification centre for the lower epiphysis of femur appears between 35th and 40th week, for the cuboid between 36th and 40th week, and for the upper epiphysis of tibia at 40th week. Roughly speaking, the biparietal diameter measures 7.6 cm. at 32 weeks, 8.3 cm. at 36 weeks and 9.5 cm. at 40 weeks. It must be added, however, that the criteria for the radiological diagnosis of maturity are not sharp enough, and all the clinical and radiological data should be intelligently put together while estimating maturity.

Placenta Praevia

Localisation of the placenta is of paramount importance in cases of antepartum haemorrhage. The conservative management

(A) *Indications for pelvimetry with or without cephalometry.*

(1) A primipara, especially an elderly one, with clinical suspicion of contracted pelvis.

(2) Malpresentations like breech, face, transverse, etc. where assessment of cephalopelvic disproportion is important and the pelvis is clinically suspected to be narrow.

(3) Midcavity and outlet contraction of the pelvis where clinical assessment is difficult.

(4) Patient with a previous bad obstetric history often deserves an accurate evaluation of her pelvis.

(5) Cases of previous caesarean section where a thorough knowledge of the pelvis may be helpful in deciding in favour of vaginal delivery.

(6) Radiological evaluation of the pelvis is often called for in the course of a labour which is not progressing normally. This evaluation is very useful in deciding between abdominal and instrumental delivery (Plate 147).

(7) Postnatal pelvimetry may be desirable on occasions. This will furnish an explanation for the difficulties experienced during the conduct of labour and also provide a useful guide for the management of future labours.

(B) *Basis of cephalopelvimetry.*

Because of the divergent nature of x-ray radiations emanating from the tube, all pelvic and cephalic diameters, as seen on the x-ray plate, are magnified to an extent depending on their distances from the film and the x-ray tube. In almost all the methods of pelvicephalometry the correction for this magnification is based on the principle of similar triangles, viz. the bases of similar triangles are proportional to their altitudes.

(C) *Methods of cephalopelvimetry.*

The following are some of the important methods in use today. They differ from each other in the way the corrections are made for the magnification of the pelvic and cephalic diameters as seen on the x-ray film.

(1) *Geometrical Methods.* The distance of the particular pelvic diameter from the film and from the tube is found and the necessary mathematical calculations are undertaken to deduce the correct diameter from the one measured on the film. Various in-

genious devices are developed to lessen or eliminate the drudgery of repeated calculations involved in this method. The use of tables, graphs (Hodges), slide rules (Snow; Schwartz; Kendig), obstetrical calculator (Snow), and nomogram (Ball) are some of these devices.

(2) Instead of undertaking the calculations, the film may be placed in a dummy apparatus and the path of the rays reconstructed by using threads. The diameter can be measured by noting the distance between the appropriate threads at the level corresponding to that occupied by the diameter when the picture was taken.

(3) *Isometric Method (Thoms)*. A metal ruler scale, with perforations or notches cut at 1 cm. intervals, is placed in the plane of the diameter to be measured. The ruler undergoes the same distortion as the diameter and the corrected diameter can be deduced from the ruler as seen on the film. While taking lateral plate, the ruler may be kept along the vertebral column or between the thighs in the genital fold. For inlet plates also, the ruler may be used with some modification but the use of Thoms grid is better. This has perforations at 1 cm. intervals.

(4) *Parallax Method*. The principle of parallax is made use of. Two exposures are made with a known tube-shift between them. The parallax shift of the diameter as noted on the radiographs is utilised for the mathematical calculations to obtain the corrected pelvic diameter. This method is favoured by Hodges and Ledoux.

(5) *Precision Stereoscopy of Caldwell and Moloy*. Radiographs are taken with a known tube-shift between them. They are viewed in a specially constructed apparatus, the Moloy precision stereoscope, so that a phantom image of the pelvis is seen by the observer. The necessary diameters can be directly measured over the phantom image.

(D) *Technique of Pelvicephalometry.*

The number of x-ray films required, the positioning of the patient for the different pictures and the exact technical details depend on the method of pelvicephalometry chosen. However, the following are the views of the pelvis most commonly utilised:

(1) *Lateral View*. This is best obtained with the patient standing erect. A centimeter metal ruler (Isometric Method of Thoms) is placed along the vertebral column or between the thighs in the genital fold. Superimposition of the acetabulae in the pic-

ture indicates correct positioning of the patient. The anteroposterior diameters of the pelvis at any plane can be easily obtained from the film. The shortest diameter of the foetal head or its circumference can also be measured. The inclination of the pelvic brim, lateral bore of the pelvis, the inclination and the curvature of the sacrum, the size of the sacrosciatic notches, the posterior projection of the ischial spines, the level of the foetal head and the manner of its engagement are some of the additional informations obtained from this view.

(2) *Brim or Inlet View.* The patient is sitting in a reclined position so that the tip of the fourth lumbar vertebra and the top of the symphysis pubis are at the same horizontal level. The pelvic brim is now parallel to the film. The correct positioning of the patient is indicated by the superimposition of the upper and the lower pubic rami and the obliteration of the obturator foramina. The transverse diameter of the inlet and the bispinous diameter can be measured. Besides, the shape of the pelvic inlet can be studied. Heavy irradiation of the foetal gonads is a great disadvantage of this view.

(3) *Anteroposterior or Frontal View.* This can be obtained with the patient standing erect or lying supine. Transverse diameter of the inlet, bispinous diameter, bituberous diameter, and the diameter or the circumference of the foetal head can be measured and the splay of the lateral pelvic walls can be studied from this view. Unfortunately, the ischial spines are very often obscured by the ileopubic bones.

(4) *Outlet View.* In Chassard and Lapine's method, the patient sits on the cassette at the edge of the table and bends sharply forward. The tube is placed vertically above the film and directed to the sacrum. In the method of Caldwell and Moloy, the patient lies supine and the tube is directed to the pubic arch at an angle of 45 degrees. The bituberous diameter and the angle of the pubic arch can be measured from the outlet view.

(E) *Radiological Prognosis of Labour.*

The ultimate aim of pelvicephalometry is to arrive at a prognosis of the outcome of labour. Once the pelvic and the cephalic diameters are obtained by any of the various methods outlined above, the prognosis can be worked out by one of the many methods referred to below. It must be remembered, however, that, besides the lengths of the different diameters of the pelvis and the

foetal head, the shape and architecture of the pelvis must also be taken into consideration.

The simplest approach to the problem of prognosis is to consider the lengths of the important pelvic diameters, like the true conjugate. However, as is well known a narrowing of the anteroposterior diameter is often adequately compensated for by a wide transverse diameter at that plane and vice versa. Hence, it is better to take into consideration the capacity of the pelvis at that plane rather than an individual diameter. Weinberg et al use the sum of the anteroposterior and transverse diameters as an index of the capacity of the pelvis at the particular plane, while Mengert uses the product of the anteroposterior and transverse diameters as an index. Nicholson calculates the area of the brim to evaluate its capacity. Moir has constructed forecast graphs for the different pelvic planes. On these graphs the pelvis in question can be 'pinpointed' after its anteroposterior and transverse diameters are known and its position compared with the 'difficulty level' line for the size of the foetal head in question. In the precision stereoscopy of Moloy and Stecr, circular disks representing the foetal heads with different biparietal diameters are compared with the different pelvic planes as seen on the phantom image of the pelvis. Ball compares the volume of the foetal head with the volumetric capacity of the smallest diameter of the pelvic plane.

(F) *Limitations of Pelvicephalometry.*

By pelvicephalometry one can find out the presence and the degree of disproportion between the size of the foetal head and the capacity of the pelvis. It is possible to know whether the passage of the head is likely to be obstructed by the bony pelvis, the level of such obstruction and the degree of obstruction. It must, however, not be lost sight of that relative proportion of the foetal head and the pelvis is but one factor contributing to a normal vaginal delivery. There are other no less important factors like adequate uterine action, mouldability of the foetal head and the behaviour of the cervix. It can, therefore, be easily realised that pelvicephalometry cannot predict the outcome of labour.

Chest X-ray

Apart from being useful in the diagnosis of diseases of lungs,

pleura, heart etc., a chest x-ray is often called for to detect secondaries in cases of choriocarcinoma (Plate 148).

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CHAPTER 6

PHYSIOTHERAPY FOR CHILDBIRTH

Ante-Natal and Relaxation Exercises:

The purpose of these exercises are

1. To help the mother to relax and by doing so, ensure a minimum of discomfort.
2. To teach the correct posture during pregnancy and thus avoid backache and the feeling of "tiredness".
3. To teach the mother which muscles to use during labour, also which not to use.

Ante-Natal Exercises:

These are recommended by the doctor in normal cases from the 4th month onwards. There are nine such exercises generally used.

1. Pelvic rocking.
2. Pelvic floor contractions
3. Squatting.
4. Ankle exercises.
5. Deep breathing.
6. Panting breathing.
7. Pushing breathing.
8. Posture.
9. Relaxation.

1. Pelvic Rocking: The aims of which are as follows:—

1. To stretch pelvic muscles.
2. To strengthen abdominal muscles—very important.
3. To stretch the tight ligaments of the Pelvis.
4. To prevent backache.
5. To increase the circulation to all parts of the body.
6. To control Pelvic tilt.

To commence:—

Lie on the floor with arms at the sides, knees bent up, so that the feet are flat on the floor near the buttocks.

Movement:—

Tighten the buttocks and pull in the abdomen so that the small of the back presses hard against the floor. The lower ribs should feel as though they are being pushed down towards the thighs. Then relax, and lift the small of the back, making it "hollow", so that the buttocks are on the floor, and the small of the back and the back of the lower ribs are off the floor.

Practice:—

Do this 5 or 6 times in the mornings and evenings, more if you have backache or feel stiff. Practice also in another starting position, such as, sitting on the floor, or on a stool. This exercise is useful during the 1st stage of labour, in between contractions, if there is a lot of backache.

2. Pelvic Floor Contractions: The aims of which are as follows:—

1. To strengthen the pelvic floor muscles. . . .
2. To prevent dribbling of urine.
3. To prevent prolapse of haemorrhoids.

To commence:

Lie on the floor with ankles crossed.

Movements:

Pull in the muscles in between the legs in front as though trying to stop urine passing. Keep the abdominal muscles flat by pulling them in. Pull in the muscles of the buttocks, especially the lower half, so that the labial cleft is nearly or quite closed, as if trying to stop from passing a stool.

Practice:

Anytime during the day—5 or 6 times especially, when coughing, laughing and sneezing, more so if you tend to dribble urine during these times.

3. Squatting: The aims are

1. To stretch the joints of the pelvis.
2. To stretch the pelvic floor muscles.
3. To stretch the abductor muscles of the t

To commence:

Stand in front of a small heavy table, the bed (if it is firm) or the bath, with feet at least 24 inches apart. The feet should be straight, not turned outwards and the heels resting on the ground.

Movements:

Put the hands close together and hold on to the bath, or table, with the elbows bent. Slowly bending the knee outwards, go down until the buttocks are nearly touching the floor. Use the elbows to push out the knees further. Push the buttocks up and out, then slowly stand up again. Watch for the tendency of the feet to turn out and the heels to rise off the floor.

Practice:

Do this exercise 3 times once a day. Holding on to the bath is the best way.

4. Ankle Exercises: The aims this time are

1. To strengthen the muscles of the ankles and feet.
2. To help the blood circulation of the feet.

To commence:

Lie on the floor. Bend the ankles up and down, in and out and in a circle.

Practice:

Do this 5 or 6 times during the day and even while sitting.

5. Panting Breathing: The aims of which are

1. To help in the first stage of labour when the contractions are strong and close together.
2. To give the uterine muscle an adequate supply of blood and oxygen.
3. To prevent yourself from pushing down.
4. To prevent strain on the cervical ligaments and tissues.

To commence:

Lie on the floor with arms at the side.

Movements:

Take a quick breath in and then out pushing the top of chest up and down. Do it quickly with the accent on the breathing in. Feel your top ribs and chest rising each time you breath in.

Practice:

Any time during the day—5 or 6 times. Change the starting position, so that you can do it in any position.

6. **Deep Breathing: (Lateral Coastal breathing):** The aims are

1. To increase the blood circulation to all parts of the body.
2. To prevent the chest wall and abdomen from being held rigid.
3. To prevent pain sensation when contractions occur.

To Commence:

Lie down, arms at the sides.

Movements:

Inspiration: Take a breath in with the mouth open, and feel the sides of the ribs round the waist move outwards as though trying to push your brassiere or belt tight.

Expiration: Let the ribs fall back, like a sigh, keep your mouth open. Then let a little more air out as though blowing a candle but not enough to put it out.

Practice:

Do this lying down, standing, sitting, walking 5 or 6 times. This exercise should not be done too often at the beginning, otherwise you may become dizzy. Practise whenever you feel painless contractions or the abdomen hardening during pregnancy, also if the baby kicks a lot at night. When true labour contractions start, you will automatically start deep breathing, either stand, sit or lie down, when the contractions finish then stop deep breathing. Start deep breathing immediately physical signs of labour begin then you will find you can set a pattern and rhythm of breathing for the contractions. Breathe slowly and deeply at first, as the contractions get stronger, make the breathing quicker and shallower, when the contractions finish, make the breathing again deeper and slower.

At the end of the contraction 2 or 3 big deep breaths help to remove any painful sensation still there.

7. Pushing Breathing: The aim is to aid in delivering the baby.

To commence:

Lie on the floor, arms at the sides with the elbows slightly bent. Knees bent up and feet resting on the floor.

Movements:

Take a deep breath in with the mouth open, close the lips tight to keep the air inside and push down as though trying to expel a constipated stool. Push down for a reasonable length of time, then open your mouth and let the air out. Take another quick breath in again, close your mouth and push down again. Feel you are pressing from above downwards with the air. The abdominal muscles should be tight and pressure from front to back, so that resultant force is downwards and backwards towards the buttocks, relaxing the pelvic floor muscles when pushing. You will get several pushes to one contraction.

Practice:

Onco or twice a day only, when bowels are full, to pass a stool.

8. Posture: Even though you are pregnant, still watch your posture.

1. Avoid putting cushions behind your back when sitting.
2. Sit on a straight backed chair, not a low reclining chair.
3. When standing hide as much of the abdomen as you can by tightening the muscles of the abdomen and buttocks.
4. Do not wear too tight clothing around the waist as this might cause swelling of the hands and feet but do not have your skirts too loose, as this will tend to make you push out your abdomen to hold up the skirt.
5. Remember to keep your legs fairly close together when you walk, so you don't "waddle" from side to side.

9. *Relaxation:* The aim is

1. To gain control of the emotions and prevent nervous fatigue.
2. To gain control of the physical side (muscles) and prevent physical fatigue.

Method of Relaxation: The room should be pleasant, comfortable and warm.

To Commence:

Lie on either side, half over on the abdomen. If on the right side the right shoulder on part of the pillow, with the right arm behind the back, the right leg straight. Bend your left knee and have a small pillow under it. Bend the left arm up in front of the face. Your clothes should be loose, glasses and ear-rings to be removed. The bladder and bowels should not be too full.

Start at the feet and consciously think of letting muscles relax. Tighten your toes, then think of "letting them go". Working up the body, let the legs feel heavy, the thighs and buttocks, let the hips go slack, and the knees sink into the pillow. Then relax the small of the back, waist, abdomen and chest. Take a small breath in and sigh it out slowly, feeling the whole body sink into the floor. Repeat 4 or 5 times. Think of the shoulder, let the arm in front go further out and the hand rest loosely on the floor. Let your neck and head sink into the pillow, relax the jaw and do not clench your teeth. Shut your eyes and let your facial muscles go.

Practice:

Every day, whenever you feel tired. Do not go on too long learning to relax at the beginning say 10-15 minutes. Get up slowly after relaxation so that the circulation has time to adjust itself.

If you have cramps in the legs, move the legs about, do not wait too long before moving your legs because they can become painful and difficult to control.

One month before delivery, you will be taken to see the delivery room, and given a talk on the stages of labour. So that you know exactly what to do when labour commences.

Post-Natal Exercises

These can be taken, whether it was a normal delivery, forceps, caesarean, and can still be done if you have perineal sutures.

The aims of the exercises are:—

1. To improve the venous circulation and prevent phlebothrombosis.
2. To stimulate the circulation in the pelvic vessels and so aid involution.
3. To restore the tone and strength of the abdominal and pelvic floor muscles.
4. To strengthen the ligaments of the pelvis and increase the flexibility of the joints of the spine.
5. To encourage good posture.

After delivery after you have had a rest:

1. Ankle exercises as for ante-natal.
2. Deep breathing as for ante-natal.

You should feel as though you take a breath in, and then let as much air out as you can. As though you are trying to blow a balloon up and put as much air in it as possible on one breath. You should feel the lower ribs and upper abdomen come in and flatten.

These two exercises should be done 5 or 6 times each every hour.

1st Day after delivery after one night's sleep:

Repeat 1 & 2 and add to it.

3. Pelvic floor contractions as for ante-natal.
4. Pelvic rocking as for ante-natal.

Make sure now that all the air is out of the chest, when tightening the abdomen and buttocks.

5. Lie on the abdomen, with a pillow under the head and another under the lower chest and abdomen. Make sure there is no pressure on the breasts. You should stay on the abdomen at least for one hour every day and at night if you feel it is comfortable. Do not do this if you have had a caesarean.
6. Measure the waist-line, and again every week until you are back to your original measurements.

2nd Day after delivery:

Repeat (1-5) and if you had a caesarean continue the same exercises for two days more and then start on the other ones.

7. Lie on the bed with the knees bent up and feet flat on the bed.

Press the small of the back down, tightening the abdomen and the buttocks. Keep them tight and flat. Lift the head and stretch the hands towards the knees. See that the air is out of the chest and the abdomen stays flat. Do not try and reach too far in the beginning with the hands.

8. Lie on the bed with the knees bent up and feet flat on the bed.

Press the small of the back down, tightening the abdomen and the buttocks, then lift the small of the back and buttocks off the bed. As you again lower the back to the bed, tighten the abdomen and buttocks, and curl up the lower spine to touch the bed. Then relax the abdomen and buttocks at the end.

These exercises should now be practised 5 or 6 times each one, after each feed of the baby. So that they are done 5 or 6 times in the day, but do not go on too long at one time.

3rd day after delivery:

Repeat (1 to 8)

9. Lie on the bed with the knees bent and the feet flat on the bed. Press the small of the back down, tightening the abdomen and buttocks, lift the head and stretch one hand to the opposite knee.

4th to the 7th day after delivery:

When allowed out of bed correct your posture. Practice the pelvic rocking exercises (4) now sitting up.

When you go home practise the exercises on the floor. Go back to wearing tight clothes so that you can see what your figure looks like and it will remind you to hold your abdomen and buttocks tight.

2nd Week after delivery:

Repeat (1 to 9)

10. Sitting on a stool with the feet flat on the ground, knees together. Tighten the abdomen and buttocks bend the head and trunk down to touch the head on the knees. Let the arms hang loosely at the sides. Come up slowly, uncurling from the small of the back, and the head up last.
11. Sitting on a stool with the feet flat on the ground. Knees

together and the bands on the hips. Turn the head and trunk from left to right several times.

12. In the same position, now bend the head and trunk to one side only. Sit up and bend to the other side.
13. Lie on the floor on the abdomen, arms at the sides. Lift one leg up behind keeping the knee straight and the toes pointed. Do the same with the other leg and then both legs.
14. Measure the waist line and hips and check the weight to see that you are not gaining any more.

4th Week after delivery:

15. Walking on the toes, feet together jumping up and down, then bend the knees and touch the floor with the hands.
Stride jumps (feet apart and together)
Walk jumps (feet forward and backwards)
16. Stand with the feet apart, and stretch the arms and hands to one side at shoulder level. The knee should be bent on this side. Swing the head and trunk down to the ground from one side to the other, and bend the other knee now. The hands should move along the ground from one foot to the other, and then come up.
17. Repeat the same, but instead of swinging from side to side, make one big circle with trunk stretching the arms, above the head, to one side, down to the ground and then up to the other side. Make sure the knees are bent, when going down to the feet.

6th Week after the delivery—not before:

18. Lie on the floor. Press the small of the back down, tightening the abdomen and buttocks and keep tight. Bend the head forward and sit up. The small of the back should be the last to come off the floor. Going down, push the small of the back behind, tightening the abdomen and buttocks and then slowly lower the trunk back to the ground. The head should be the last to touch the bed, and when down, then relax the abdomen and buttocks.
19. Lie on the floor, with the knees bent up and the feet flat on the floor. Press the small of the back down, tighten up the abdomen and buttocks. Lift the feet off the floor and bend the knees up, then straighten the legs bicycle

them in the air slowly. They should make as big a circle as you can going right down till the foot is just an inch of the floor. Feel as though you can only just touch the pedals with your toes, so that you push out as far as you can with your legs. Practise it only two or three times with each leg, then rest and start again.

To Prevent Backache and Overstrain Back

Avoid stooping or bending of the back too much, especially never do it with the knees straight. When lifting a child from the floor or anything heavy from a low table, put the feet one in front of the other, and keep the back straight and bend the knees. Draw the child close to you, and stand up by straightening the knees. Do the same when putting anything on the floor.

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SECTION XIII

THE NEWBORN

CHAPTER 1

PHYSIOLOGY AND MANAGEMENT

The newborn infant makes a number of physiological adjustments for its survival as an independent being. The most vital changes involve the respiratory, circulatory, digestive and urinary tracts.

The respiratory tract must start functioning immediately after birth. The mechanism initiating the first breath is not entirely known, but it is presumed that the high carbon dioxide level in the blood stimulates the respiratory centre. The first respiratory movements produce inflation of the lungs particularly at the apices and anterior aspect. It takes a few days or weeks to bring about full expansion of the lungs. Cyanosis is common if the rate and depth of respiration are irregular. This occurs more frequently in premature babies. Aspiration of amniotic fluid containing vernix caseosa, lanugo and desquamated epithelium is fairly common. The air passage, therefore, should be cleared as soon as the baby is delivered. This explains the high incidence of respiratory tract infections in the newborn. The presence of a pulmonary infection cannot always be clinically detected, though it might be suspected; but autopsy evidence has been found in a number of cases of neonatal death.

The circulatory system undergoes important anatomic and physiologic alterations consequent to the onset of respiration. In the foetus, oxygenated blood carried by the umbilical vein is shunted from the right auricle into the left auricle through the foramen ovale, while a small portion enters the right ventricle, pulmonary artery, and through the ductus arteriosus, enters the aorta. Venous blood is carried back to the placenta through the umbilical arteries. Once respiration begins, the pulmonary vascular bed expands, as the lungs take up the function of oxygenation. The fora-

men ovale and ductus arteriosus are physiologically closed soon after birth, and become obliterated within 2 to 3 months.

The cardiac rate in the sleeping newborn baby is about 120 per minute. The normal blood pressure at birth is 55 mm. Hg. systolic and 40 mm. Hg. diastolic. The systolic pressure gradually rises to 75 or 80 by the end of the first month.

Changes in the blood are mainly related to destruction of the excess red blood corpuscles which are not required once efficient oxygenation is established. The red blood cell count in umbilical vein blood is 6-7 million per c. mm. and the hemoglobin percentage varies from 17 to 20 G. per cent. By the tenth day of life, the hemoglobin usually falls by about 10% of the birth value. Late normoblasts are usually seen in the peripheral smear and in the number of 5 per 100 white blood cells. The normal reticulocyte count in the first few days is 2-6%. A high reticulocyte count and an increase in the number of normoblasts are seen in hemolytic disease of the newborn.

The digestive system begins functioning after birth. A normal newborn is able to suck and swallow well. Prematurity, intracranial injury, and abnormalities like barelip and cleft palate are the causes of poor sucking and swallowing. Dentition precox or teeth at birth are occasionally found. They have no roots and are usually shed within the first month. The stomach capacity at birth is 20 ml. to 30 ml., increasing rapidly to 100-120 ml. by the end of the first week. The emptying time of the stomach is about three hours, and feeds should therefore not be given at shorter intervals. Hydrochloric acid in the stomach is present at birth but remains low during the first two months. The digestive enzymes in the intestines are present from birth, though amylase secretion is somewhat deficient to start with, and the infant is capable of digesting proteins, fats and carbohydrates.

The stools undergo normal transitional changes. During the first three to four days, meconium is passed—dark green, thick and viscid consisting of mucus, intestinal secretions, vernix and desquamated epithelial cells. They gradually become greenish brown in colour, thin and sour smelling. By the 8th or 9th day, the stools of a breast fed baby are of a golden yellow color and have a thin pasty consistency. An artificially fed infant has stools which are paler in colour, and somewhat drier. During the first week, the baby has as many as six to seven stools daily, often one after every feed. By the end of the second week it has three to four stools

daily. The number of stools is usually fewer in a bottle fed baby. Many an infant is considered to have diarrhoea if one is unfamiliar with the nature and number of stool normally passed during the first 2 weeks of life. It is unfortunate to see a baby who is actually doing well on his mother's milk, weaned unnecessarily early because of a mistaken feeling that the breast milk is either excessive or inadequate, or not tolerated by the baby. The initial greater frequency of stools has been attributed to irritation of intestinal mucosa by the milk, and to the first invasion of the intestine by bacteria.

The liver of the newborn infant is anatomically proportionately larger though it is physiologically immature. The excretion of bile is slow and inefficient. The enzyme systems are not fully developed. The liver and spleen retain their erythropoietic function.

Urogenital system. The kidneys do not start functioning fully till the end of the first week. During the first few days urine is passed infrequently. Some children do not micturate at all in the first 24-48 hours. Excretion of salt is imperfect in the first few days and accordingly salt solutions should be administered sparingly to a newborn infant. Occasionally the urine may be coloured pink. This is presumed to be a result of uric acid infarcts in the kidney. The excessive uric acid production is due to the destruction of leucocytes. Mild albuminuria is sometimes seen and is a transient phenomenon.

Girl babies often have a small amount of whitish secretion from the vagina and at times even bleeding per vaginam. Follicular hormone from the maternal circulation is responsible. The bleeding usually occurs on the 3rd or 4th day and lasts for 2 to 3 days. No treatment is required. Breast secretion is sometimes found due to the same cause and it too subsides spontaneously. Efforts to extract it are inadvisable and promote the entry of infection.

Central Nervous System. The cerebral function is not fully developed at birth. The baby wakes and cries when hungry, wet or uncomfortable, but otherwise sleeps through the day and night, unaware of its surroundings. It is not until the end of the second month that the child becomes more active, wakeful and interested in the world around him. It is able to distinguish light and dark but cannot focus its gaze on any specific objects. Many babies appear to have a squint when they are born. Not until the third

month do they develop adequate co-ordination of the muscles of the eyeball to follow moving objects. The infant is said to be unable to hear until the eustachian tubes are aerated. Pain sensations are better tolerated now than later. Crying is the response to excessive heat or cold. Feeding and sleeping habits and conditioned reflexes develop rapidly showing that the infant is able to learn fast.

The deep reflexes are not always easy to elicit. A certain amount of rigidity is normal at birth. Ankle clonus is an abnormal sign and is helpful in distinguishing rigidity that is normal from that which is excessive and a result of brain damage. The plantar reflex is variable and the Babinski phenomenon may be present in a normal infant. The cremasteric reflex is vigorous, though the abdominals are inconsistent. The pupils respond to light with constriction followed by dilatation. The Moro reflex should be present in all normal infants. Its absence is indicative of intracranial damage. It is elicited by any loud noise or by thumping firmly on the mattress on either side of the baby, in response to which, the baby extends and abducts its limbs and then adducts them in an action like an embrace.

Changes in Shape and Size of Head. The child is usually born with some evidence of moulding which disappears by the third or fourth day. The caput succedaneum which is the oedematous area of the presenting portion of the scalp also clears in a few days. Cephalhematoma is an area of subperiosteal hemorrhage over the parietal bones and may take one to eight weeks to clear up depending on its size. None of these conditions have any lasting effect on the shape or size of the head. A depressed skull fracture resulting from birth trauma can cause permanent damage unless well treated. Dehydration will cause the skull sutures to overlap and hydrocephalus will have the reverse effect. Occasionally in a premature infant or even a term infant of a mother with osteomalacia, the sutures may give a false impression of being widely separated. In these cases the circumference of the skull is within normal limits and the anterior fontanelle is not bulging. The sutures appear separated because the bones are not completely calcified. With administration of vitamin supplements calcification proceeds normally and by the age of two months the sutures are in apposition.

Weight. The average weight of a mature full term infant is 3.3 kg. Those with birth weight less than 2.3 to 2.5 kg. are con-

sidered premature. Normal infants can have birth weights upto 4 to 4.5 kg. Larger infants suggest prolonged gestation or the presence of diabetes in the mother. In some instances a prolonged pregnancy may result in loss of weight. During the first four to five days most babies lose upto 10% of their birth weight, and as lactation sets in, the birth weight is regained some time during the second week. The weight loss is due partly to a low intake and also to loss through the passage of stool and urine and perspiration. The birth weight of the infant is said to be dependent on the race, health and stature of the parents. Infants of women who are undernourished or ill are often below average in weight. The average birth weight of children born at the Nowrosjee Wadia Maternity Hospital, where the patients are from the lower socio-economic groups is 2.8 kg. On an average, from the 10th day on, the baby gains 220 to 250 gms. every week although individual variations are frequently found. Some babies take a longer time to start gaining, but in the absence of actual illness, this need not cause concern. Attempts to force feeding will only cause gastrointestinal upset.

Length. The length of babies born at term varies between 48-52 cm. The upper segment of the body measured from the top of the head to the symphysis pubis is longer than the lower. The proportion of upper to lower segment is about 1.7 to 1. The head circumference is 34 cm. at birth, and increases by 2.5 cm. by the end of the first month. The head forms 25% of the body length and is obviously proportionately longer than it is later as the child grows. At birth the chest circumference is usually 2-3 cm. less than the head circumference. The umbilicus is situated below the mid-point of the body. The span across both arms is greater than the body length as the arms are longer than the legs. The foot length is just over 8 cm. Both fontanelle are open at birth but are of variable size. The posterior fontanelle just about takes a finger tip and the anterior fontanelle is approximately 2.5 by 2 cm.

Temperature. The body temperature of the fetus at birth is 1°F. higher than that of the mother, but drops by 1-2° soon after. The temperature can fluctuate easily. Because of the greater surface area compared to its weight, the baby can lose heat by radiation very easily, and therefore should be well covered when the atmospheric temperature is low. Occasionally a newborn infant may have a rise in temperature on the second or third day, particularly in hot weather. This is a dehydration fever due to insuffi-

cient fluid intake and is easily corrected by offering water frequently to the infant.

Metabolism. Since the fetus is supplied by prepared nutrient material from the placental blood and the energy requirements are low, the metabolic rate is also low. Immediately after birth, the metabolism rises, but falls soon after, to increase again by the 5th day. From then on the metabolic rate is more rapid than in adults. The amount of nutrition required is proportionately greater to allow for growth in addition to maintenance and the amount necessary for crying and muscular activity.

Care of Newborn Infant

Respiration. As soon as the baby is born it should be received on a sterile towel and kept warm. The establishment of respiration is the most important factor requiring attention. A normal full term infant will cry immediately after delivery, thus establishing extrauterine respiration with aeration of the lungs. The baby's colour rapidly changes from dark purple to bright pink.

Whenever possible, before the baby takes the first breath, mucus from the pharynx should be gently removed with a catheter to prevent aspiration into the lungs. Oxygen inhalation by mask or funnel should be started if spontaneous breathing is delayed. If the condition still does not improve it is worth passing a stiff rubber catheter into the trachea using a direct laryngoscope, and aspirating any inhaled material or mucus plugs which might be obstructing the trachea. Introduction of oxygen directly through the tracheal catheter under controlled pressure should only be undertaken by somebody with experience in the technique, as risk of alveolar rupture is high. There are various types of mechanical resuscitators devised to initiate respiration until the baby breathes spontaneously. Their usefulness depends upon the dexterity and speed with which they are used. Intragastric administration of oxygen has been tried. Its effect if any lies in stimulating respiration. Little oxygen is absorbed from the stomach, certainly not enough in itself to provide adequate oxygenation. Drugs like lobeline and coramine have limited usefulness. Alpha lobeline in a dose of 3 mgm. is probably best for babies whose mothers have received large doses of sedatives during labour.

Cord. The umbilical cord should be divided after pulsations cease, in the case of normal infants. If the baby is suspected of

having hemolytic disease, the cord should be ligated immediately to prevent more antibodies from entering the child's circulation. In the case of babies born after difficult labour, or any infant who does not breathe or cry spontaneously, it is wiser to cut the cord quickly and concentrate on establishing respiration as soon as possible. Approximately 100 ml. of extra blood enter the child's circulation if the cord is ligated after pulsations cease. The cord usually drops between the 7th and 10th day.

Bath. It is customary to give the baby a bath within a few hours after birth to remove the vernix and blood. In some countries, this practise is being given up in maternity hospitals, as they believe that it leads to a greater incidence of staphylococcal infections. Gently cleaning the skin with a little oil is probably adequate. In India it is still the practice to put oil into the ears and nose of all babies. This is actually quite undesirable as inhalation of oil can produce lipoid pneumonia and oil in the ears mixes with the wax and gives rise to hard masses which irritate the external ear. It is not necessary to clean the baby's mouth at all. Only if there is a thrush infection, should gentian violet be used to control the infection. Girl babies often have a white vaginal discharge. Apart from wiping it off with moist sterile cotton, it needs no other applications. In boys who have a tight foreskin, gentle stretching done on about the 7th day is adequate to ensure sufficient retraction to allow proper cleansing.

Feeding. No feeds are given for the first 12 hours, in order to let both baby and mother get some rest. The first feed given should be of boiled water only, so that if vomiting occurs, too much harm will not have been done. If the baby swallows and retains the water easily, breast feeds should be started. Babies born after difficult or operative delivery, should not be given any feeds for 24 hours, to allow the child to recover from the shock of birth trauma. In some cases, where the child is very vigorous and is crying hungrily, there is no harm in giving a small feed earlier. Most babies of 3 kg. and over, do well on a 4 hourly feeding schedule, only a few initially weak ones may require 3 hourly feeds. Keeping to a reasonably regular schedule usually works out better in practice than so-called self demand feeding. Every effort must be made to encourage breast feeding. It is the food most suited to the baby's needs, is sterile and more easily digested and assimilated than any other. The incidence of diarrhoea is considerably lower in babies who are entirely breast fed. This applies

most particularly in India, where the standard of sanitation is poor, and knowledge of good hygiene is negligible in the general population. If the need for supplementary feeds is imperative, one of the proprietary modified milk formulae can be used in half-dilution strength for the first 2 days, gradually increasing to full strength by the 5th day.

Clothing. The clothes used should be suited to the climate. In a warm climate, simple cotton clothing is best. Covering the child excessively makes him hot and uncomfortable with the result that he cries frequently, and also tends to get dehydration fever, and a heat rash. In cooler climates, warm flannel garments, worn over a cotton one is best.

Multi-vitamin drops should be started by the end of the first week. The water miscible kind are best as oily solutions can cause gastrointestinal upsets.

CHAPTER 2

PREMATURITY

According to international standards, any infant weighing 2.5 kg. (5½ lbs.) or less at birth is regarded as a premature baby, irrespective of the period of gestation. It has often been suggested that in our country the weight standard be reduced as the average birth weight is low, but a 4 lb. baby can and often does have the same problems and require the same specialised care as those born before term.

The incidence of prematurity, as quoted by Crosse, is 8.2% of all births. But 47.5% of still-births, 59% of neonatal deaths and 41.4% of all infant deaths were in prematures.

Etiology: The maternal causes of prematurity are: (1) multiple pregnancy, (2) maternal complications such as toxæmia, acute and chronic illnesses, genital tract anomalies, (3) premature separation of the placenta, (4) premature rupture of membranes, (5) very young primipara, (6) malnutrition.

— The foetal causes of prematurity are congenital malformations. Conditions like oesophageal atresia, intestinal atresia and severe malformations of the heart are often associated with prematurity.

Characteristics of Prematurity. They vary with the degree of prematurity, being most marked in the least mature infant.

Length. The average length of a premature infant is less than 45 cm. (18 inches). There is a constant relationship between the length and the degree of prematurity—that is, the length in inches is equal to half the number of weeks of maturity.

Weight. The average weekly gain in weight in utero is 5 ozs. from 28-32 weeks; 7 ozs. from 32-36 weeks and 8 ozs. from 36-40 weeks.

The loss of weight during the first few days of life is relatively greater in the premature baby than in the full-term baby, the percentage of weight lost increasing as the birth-weight decreases. The weight lost is usually more than 10% of the birth weight. This initial loss is regained more slowly, the birth weight often not being regained until the 3rd week in the case of the smaller infants. Later the growth is relatively more rapid.

The general proportions vary in that the abdomen appears

large and the chest looks small. The extremities are thin and the umbilicus is nearer to the symphysis pubis. The head is proportionately larger than in a full-term infant.

The vitality of these infants tends to be low. Their body temperature is subnormal because of poor heat production and increased heat loss. The low intake of food, lack of normal muscular activity and feeble respiration account for deficient heat production. The relatively greater body surface and lack of subcutaneous fat accounts for the proportionately greater heat loss. The heat regulating centre is also poorly developed.

Respiratory System. Respiration is affected because of local pulmonary and central factors. The lung tissue is poorly developed. The alveoli are lined with low cubical epithelium surrounded by few blood vessels. The respiratory muscles are weak and the thoracic cage yields more easily. With poor development of the respiratory centre, respiration is often irregular and shallow, with periods of apnea and cyanosis. The cough reflex is absent in the more feeble infants leading to a marked tendency to regurgitate fluids. The nasal passages are narrow and the mucous membrane bruises easily.

Circulation. The peripheral circulation is poor with weak friable blood vessels. The heart is often slow and feeble.

Blood. The normal changes in a newborn's blood are accentuated in a premature baby. The hemoglobin value and red blood cell count are higher than normal at birth. More immature cells are present in the peripheral blood. The destruction of red cells is greater, and the final rise is slower. This excessive breakdown more commonly produces jaundice which is severe and prolonged. The liver function is poor and therefore the conjugation of indirect bilirubin is affected. The low prothrombin concentration predisposes to hemorrhage. Low serum protein (4.5 G.%) increases the tendency to develop oedema.

Digestive System. Due to immaturity of the digestive system, the sucking and swallowing reflexes are poor. The opening of the oesophagus into the stomach is patulous and the pylorus is hypertonic explaining the frequent occurrence of regurgitation. Fats are poorly tolerated. The musculature of the bowel wall is weak and easily distended. Normal peristalsis can often be seen through the thin abdominal wall.

Kidney Function. Kidney function takes a longer time to come

up to normal. The urine is infrequent and scanty for the first few days. Albumin often appears. The position of the kidneys is somewhat lower.

In the female the labia minora are not covered by the labia majora. In male babies, the testes may not have descended.

Nervous System. It is noticeably immature. Stimulation produces slow movements and a feeble cry. The centres controlling respiration, the cough reflex, swallowing and sucking, and body temperature equilibrium are all poorly developed. Often the rectal temperature may be elevated, while the child feels cold to the touch externally.

There is little subcutaneous fat, the skin is wrinkled and the baby appears more red. The hair and eyebrows are scanty. The nails do not project beyond the finger-tips.

Effects of Labour on a Premature Baby. They are more prone to intracranial injury because of the soft skull bones and the frequency of breech presentations. The low prothrombin content and friable blood vessels predispose to intracranial hemorrhage. Uterine stimulants are inadvisable. Sedatives should not be given to the mother.

Infection is a great danger. Aseptic conditions should be strictly enforced in the labour room. Personnel suffering from any infection should not come in contact with the baby.

During delivery the baby should receive minimal handling. As soon as the baby is born it should be wrapped in sterile towels, placed on a side and the throat cleared with a sterile catheter. Aspiration of the stomach contents is advisable if there is a possibility, perhaps during a prolonged labour, or breech delivery, or caesarean, of the baby having swallowed amniotic fluid and blood. Blood in the stomach frequently produces vomiting which in turn may be inhaled into the lungs. If respiration is not established spontaneously, the infant laryngoscope should be used to visualise and clear the larynx, and oxygen given directly into the posterior pharynx. Intubation should be gently performed if required and oxygen given directly intratracheally. The older violent methods of resuscitation should never be used. Stimulants are generally not of much help and may be harmful as the margin of safety is narrow. Twenty five mgm. of caffeine sodium benzoate may be used. The cord should be clamped when pulsations have ceased, except in cases where hemolytic disease is suspected.

Nursing Care

For optimal results, premature babies should be cared for in a nursery staffed by nurses who have the training and experience in handling these babies. A great deal of the responsibility for the care of premature infants rests on the nurses. A separate nursery is essential to provide the isolation required to prevent infection. Premature infants are highly susceptible to infection and once infected, respond poorly to treatment. The nursery should be accessible only to the doctors and nurses directly connected with the care of the babies. Relatives and visitors should not be permitted to enter. Any member of the staff with a skin, or respiratory infection should stay away from the nursery until it has completely healed. The nurses must make a habit of washing their hands before preparing feeds or putting teats on bottles, before giving a feed, or supervising breast feeding, after changing the napkin, and before touching the infant's mouth. All clothes and bed linen which come in direct contact with the baby's skin should be autoclaved. The floors, walls and windows should be cleaned with damp dusters.

The greatest gentleness should be exercised in handling these babies. Until the infant is strong enough to tolerate handling without regurgitation or change of colour, it should not be removed from the cot for changing, feeding, or cleaning. Any handling must take place before and not after a feed to avoid regurgitation. The infant should be placed on the right side at the time of and soon after a feed, and on the left side in between feeds. They should never be lying on the back or stomach, as otherwise vomiting easily occurs and may be inhaled. After any form of handling, the nurse must watch the infant carefully for cyanosis or regurgitation. The napkins should be changed just before a feed; it is not necessary to change them any more frequently.

The babies' temperature should be taken twice daily; more often only if there is some abnormality. The body temperature should be stable between 97° and 98°F. The temperature of the nursery should ideally be about 75°F. If the temperature of the baby is below 97° the baby should be wrapped in a blanket and kept warm with the aid of a heat lamp or an incubator. The temperature should be taken every 3 hours until it is stabilised.

Oxygen, if required, is given by funnel or mask, or the baby is kept in an atmosphere of 40% oxygen in an incubator.

Bathing and Cleaning. Very small babies do not need to be

cleaned at all initially. On the second or third day, cleaning can be done with warm sterile oil or liquid paraffin. When the infant reaches 2 kg. and is well, a water bath can be given on alternate days, with oil cleaning on the other days. It is not necessary to clean the mouth or ears or eyes except when there is an infection. The skin around the cord should be cleaned with 70% alcohol. If the buttocks are sore, baby lotion or a mild zinc castor oil cream can be applied. Soiled diapers should be kept in a covered bucket outside the nursery.

The clothing should be of cotton for warm weather and flannel for colder climates. It should be simple and easily removable.

The babies should be weighed twice weekly as a routine.

Incubators and isolettes are certainly useful in nursing the smaller, more feeble infants, particularly those with respiratory problems. A good incubator provides isolation, and heat, oxygen and humidity control, but they need careful and frequent adjustment to provide a suitable atmosphere. Incubators are not absolutely necessary; it is possible to nurse even the smallest infant quite successfully in an open cot.

Feeding. The proper feeding of a premature baby is of great importance. There are several difficulties which are not encountered in a mature infant. The smaller babies are not able to suck well. The muscles of the palate, tongue and cheeks are weak and the nervous system is immature. When suction is weak, swallowing is usually not possible. If these babies are given feeds by mouth, the milk will invariably be inhaled into the respiratory tract. The cardiac opening of the stomach is patulous and the pylorus is tightly closed. Regurgitation of milk can therefore occur very easily if large amounts are given, or if feeds are given too frequently, or if the baby is handled right after a feed.

The digestive system is also poorly developed and fats in particular are not well tolerated. The composition of the feed has to be suitably adjusted. Abdominal distension occurs easily and can cause regurgitation as well as respiratory embarrassment by upward pressure on the diaphragm.

For the first 24 hours it is not necessary to give the baby any feeds. Occasionally an active infant who is crying vigorously may be given the first feed 12 hours after birth. The smaller infants with respiratory instability can safely be starved for 48 to 72 hours, until they improve.

In any case, the first two feeds should be only of boiled water

or sterile 5% glucose solution. If these are well retained, milk feeds can be safely started. If vomiting occurs, the next two feeds should be omitted and a smaller quantity given subsequently. A three hour interval between feeds has been found to be most practical.

Amount of Food Required Daily. The baby needs enough food to maintain life and prevent excessive loss of weight or dehydration. Overfeeding must be avoided. It is safer to underfeed than overfeed. A slow weight gain is better than attempts to make the baby gain more rapidly. Feeds in excess of what can be tolerated by the baby always lead to vomiting and respiratory difficulty, diarrhoea and dehydration.

At the end of the first week a sufficient food intake should provide 120-150 c.c. of fluid per kg. body weight in 24 hours and 90-120 calories per kg. body weight in 24 hours. To start with, one fourth to half this quantity should be given with gradual increases in feeds as the baby progresses. The requirement in the first few days is low as their activity is minimal and the available fat reserves, though small, are adequate to cover maintenance.

A premature infant is expected to lose 12-15% of the body weight in the first week and gradually makes it up by the time it is 20 days old, as against a full term infant who regains the birth weight by the tenth day. Even after they have regained the birth weight the rate of gain is slow. All attempts to hasten it will be dangerous. Survival with a slow steady gain gives the best results.

Quantity of Each Feed. The first feeds of water should not exceed 5 c.c. in a baby under 1 kg., 8 c.c. in a baby under 1.5 kg. Increase in the volume of the feed must be very gradual—not exceeding 2 cc./feed/day in the smaller baby. The somewhat larger more vigorous 2 kg. baby can be given increases of 5 cc./feed/day. It is the nurse's duty to watch the baby for distension, fatigue, cyanosis or regurgitation each time the feed is given. If any of these symptoms occur, that feed should be immediately stopped and subsequent feeds given in smaller quantity with an even slower increase later.

Breast Milk. Breast milk is the best food available and an attempt must be made to encourage and preserve maternal lactation. The breasts should be emptied at regular intervals. Until the infant is able to suck directly at the breast, expressed milk should be given by tube or bottle. For the smaller baby it might be wise to dilute the milk with an equal quantity of water for the

first 3-4 days, then with one-fourth the quantity of water for the next 4-5 days. By the tenth day, undiluted breast milk can be given. The mother must wash her hands and the breast, and the milk collected in a sterile receptacle.

Artificial Feeding. Feeds low in fat and high in protein and carbohydrate are most easily digested. The small baby utilises and requires carbohydrate to a much greater extent than the larger full term baby. Carbohydrate should make up 5-6% of the feed. The protein requirement is also high and should be 3-4 G.% by the end of the second week.

Various milk preparations have been used. A half-cream dried milk powder to which 1-2 teaspoons of sugar or dextrimaltose is added to every 100 cc. of reconstituted milk is probably best. Dried or evaporated milk gives a more constant composition than fresh milk.

If half-cream dried milk powder is not available fresh cow's milk can be used after boiling and dilution, with the addition of skimmed milk and sugar. The standard formula made up for the babies in the premature nursery at the Nowrosjee Wadia Maternity Hospital, Bombay, is, 50 cc. cow's milk + 50 cc. water + 8. G. skimmed milk powder + 5 G. sugar. This is the formula the baby will get by the 8th to 10th day. The first 3-4 days, it receives this formula diluted 1:1 with water. In the next 3-4 days, a 3:1 dilution of formula and water is used.

Preparation of Feeds. The feeds should be prepared under absolutely sterile, aseptic conditions and stored in a refrigerator until used. Sterility must be observed by the nurses in respect of cleaning and boiling and filling the bottles and when giving the feed. This point cannot be overemphasized. The premature baby is extremely susceptible to gastro-intestinal infections and these infections, once started, are difficult to control and spread rapidly through the nursery.

Method of Giving Feed. If an infant can suck and swallow well, it is initially given feeds by bottle and then put to the breast under observation as it improves. Babies who cannot suck, or fatigue easily must be fed by intragastric tube.

Bottle fed babies should be held on the nurse's arm with the head slightly raised. At the middle and again at the end, of the feed, the baby must be raised to help it to bring up the wind. At the end of the feed, the baby must be placed on its right side.

Tube feeding is done using a No. 4 catheter which is boiled

each time it is to be used. The length of catheter to be used is judged by measuring the distance from the bridge of the nose to the xiphisternum. The catheter is passed through the mouth and not through the nose, as the nasal mucosa is very easily injured. The outer end of the catheter should be immersed in a bowl of water to make sure it is not in the trachea. The tube is then connected to a funnel or a syringe and the milk allowed to flow down by gravity. At the end of the feed, the tube is pinched and quickly withdrawn and the baby turned on the right side after it has brought up the wind. It is worth spending a few extra minutes bringing up the wind, as it will considerably reduce the frequency of vomiting.

When a polythene tube, suitable for intra-gastric feeding, is available it is the most convenient tool. The tube can remain in place for 3 days, when it should be removed and a fresh one inserted.

The nurse should always record on a chart, the quantity of feed taken each time and the general condition of the baby at the end of the feed. A baby who is unable to retain an adequate quantity of fluid, may need additional fluids given by the subcutaneous or intravenous route to prevent or treat dehydration.

Vitamin drops containing 4000 units vitamin A, 1000 units vitamin D and 100 mgm. vitamin C are started on the 8th day routinely.

Complications of Prematurity

1. *Respiratory diseases*, such as primary and secondary atelectasis, and hyaline membrane disease, often occur. The baby lies quietly, is cyanosed, the respiration is shallow and grunting with retraction of the subcostal margin. A chest x-ray (portable, taken in the nursery) helps to confirm the diagnosis. The treatment consists of (1) frequent suctioning of the pharynx, (2) 40% oxygen and a high humidity atmosphere and (3) antibiotics such as penicillin 50,000 units 6-8 hourly, and tetracycline 30-40 mgm/kg. body weight per day.

2. *Intracranial hemorrhage* is more common in prematures because of the soft skull bones being more easily compressed, the fragility of the blood vessels and the low prothrombin content. These babies have a poor cry at birth, cyanosis, twitchings and convulsions and vomiting. They are best managed by minimal

handling, vitamin K 2 mgm., and sedation for convulsions. If the fontanelle appears boggy and a subdural hematoma is suspected, a subdural tap may be performed.

3. *Hemorrhagic disease of the newborn with bleeding from the umbilicus or the mucous membranes* requires treatment with daily injections of vitamin K 2 mgm. and fresh blood transfusions as often as necessary.

4. *Jaundice.* Physiological jaundice is more intense and lasts longer because of hepatic immaturity. Kernicterus may occur without any evidence of isoimmunisation. Exchange transfusions give equivocal results.

5. *Infections.* Premature babies have a very low immunity to infection. The gamma globulin content is low and therefore antibodies are not formed. The white blood cells do not have the normal power of phagocytosis. Infections once set in, rapidly spread through the blood stream. The infecting organism may enter through the umbilicus, the mucous membranes, the skin, or through the respiratory or gastro-intestinal tracts.

Thrush, an infection of the mucous membrane of the mouth by the fungus *monilia albicans*, is fairly common and if severe can extend into the gastro-intestinal or respiratory tract. The infection comes from bottles or hands contaminated with the fungus or from contact with other infants. It can be treated by application with 1% gentian violet or "mycostatin" solution.

Diarrhoea due to bacterial or virus infection is caused by unclean bottles or hands. Vomiting is the first symptom to appear, followed by frequent, watery, green stools. Dehydration develops rapidly, with loss of skin turgor, dry tongue, sunken eyes, depression of the fontanelle and the onset of acidosis and peripheral failure.

Treatment should be commenced with feeds of plain water or a hypotonic electrolyte solution on the first day, followed by a diluted skimmed milk formula. Antibiotics known to act on enteric infections, e.g. chloramphenicol 50 mgm/kg. 24 hours, or neomycin sulphate 35 mgm/kg/day should be given. Parenteral fluid therapy is started, using 5% glucose solution with 1/6 molar sodium lactate if acidosis is present. The intravenous fluids must be given very slowly in carefully calculated quantities in two or three instalments during the day. Rapid overloading with circulatory embarrassment must be avoided.

Skin infections like impetigo and pustular lesions should be

treated with local applications of antiseptic solutions if small and localised, but with any tendency to spread, parenteral or oral antibiotics must be administered. In the presence of abscess formation, tetracycline or erythromycin must be given. If possible, bacterial culture and antibiotic sensitivity tests should be done.

Umbilical infections need prompt antibiotic coverage, particularly if there is induration and redness of surrounding skin. The stump itself should be cleaned with 70% alcohol and covered with tincture benzoin.

Pneumonia, particularly following an aspirated feed, is often encountered. Cough is usually absent, and the symptoms are cyanosis and respiratory distress with fast laboured breathing. Treatment with antibiotics, oxygen and high humidity should be immediately instituted.

Conjunctivitis is another infection which spreads rapidly through a nursery. An appropriate antibiotic ointment used three or four times a day should bring it rapidly under control.

The trouble with sepsis in a premature infant is that often there are no localising signs whatsoever. A baby who had been doing well, suddenly looks listless, develops vomiting, does not tolerate the feeds it had before, and the general condition deteriorates rapidly. A blood culture is perhaps the only way of making a diagnosis. Any child with an infection should be isolated away from the well babies and terminal sterilization of all instruments, clothing and bedding that have come in contact with the baby must be meticulously carried out.

6. *Anaemia*. The early anaemia noticed in the first two weeks is usually hemolytic in origin due to exaggeration of the normal physiological changes in the newborn made worse in the presence of an infection. The blood contains more immature red cells, thereby increasing the fragility and accounting for a greater initial fall in hemoglobin. If the hemoglobin falls below 9 G% during the first two months, a transfusion will be required. The anaemia seen in the third month is of hypochromic type. The premature baby is apt to suffer from iron deficiency because of lack of antenatal storage of iron, the relatively greater growth after birth, and the frequency of infections. This type of anaemia responds well to the administration of iron from the 6th week onwards.

7. *Congenital abnormalities* occur commonly in premature infants. In those requiring surgical treatment, operative measures

should be held off until the baby's weight has reached 3 kg. whenever possible.

Discharge from Hospital. Ideally, the premature baby should stay in the nursery until the weight has reached 2.5 kg. but if conditions necessitate, a baby weighing 2 kg. who is sucking and swallowing well, whose activity is good and does not have cyanotic spells, can be discharged. The mother should be instructed regarding the necessity for absolute cleanliness and taught how to prepare and give a feed. She should bring the baby every two weeks for a routine physical examination, and advice regarding changes in feeds, and iron and vitamin supplements.

CHAPTER 3

GASTROINTESTINAL DISORDERS OF THE NEWBORN

These can best be discussed by taking the two symptoms most frequently noted, viz. vomiting and diarrhoea.

Vomiting in the Newborn

1. *Swallowed Amniotic Fluid or Blood.* The vomiting occurs on the first day or soon after. The child vomits perhaps one to three times a day, not necessarily in relation to the intake of water or milk. The vomitus has the dark brown appearance of altered blood. The symptom usually clears up by itself, but if it persists a stomach wash with normal saline will quickly put a stop to it.

2. *Improper Feeding.* Faulty feeding can cause vomiting in several ways. The quantity of milk at each feed may be more than is required for that age and weight. The capacity of the stomach on the first day of life is about 1 oz. and it steadily increases so that by the end of the week a full term child takes about 3 oz. at a time. A normal infant takes about 10 to 15 minutes to finish a feed. If the milk is swallowed very rapidly vomiting may be induced. This applies particularly to bottle fed babies, where the hole in the nipple may be too large. If successive feeds are given at too short a time interval, the stomach can get too distended and lead to vomiting. Most babies of 3 kg. and over can do well on a four hourly feeding schedule, although some may require a feed every three hours. Excessive swallowing of air during feeding can also distend the stomach. Care taken to bring up the wind at the end of the feed is always time well spent.

3. *Intracranial Injury.* The vomiting here is frequent, and not related to feeds. The baby usually does not take feeds well, is drowsy and may have convulsions and later develop coma and irregular breathing. Vomiting subsides as the intracranial condition improves.

4. *Oesophageal Atresia, with or without Tracheo-oesophageal fistula.* In this condition, because of the obstruction, even saliva

cannot be swallowed. The pharynx is full of sticky mucus, which when inhaled into the bronchi, leads to attacks of cyanosis. Any feed, if at all given, regurgitates immediately. The inability to pass a catheter into the stomach, makes the diagnosis obvious and immediate surgical correction is required.

5. *Congenital Intestinal Obstruction.* Vomiting starts on the first or second day, is projectile, frequent, unrelated to feeds, and, if the obstruction is below the second part of the duodenum, the vomitus is of a greenish-yellow color because of the presence of bile. Meconium may be passed in small quantity on the first day, but no stools are passed later. The diagnosis is easily confirmed by taking a plain X-ray of the abdomen with the patient in the vertical position, which will show the air and fluid levels. The gas pattern gives some information on the level of the obstruction, although the exact nature of the lesion, be it atresia, malrotation, or annular pancreas etc., may not be entirely clear till laparotomy is undertaken. Early surgery offers the only hope of cure.

6. *Pyloric Stenosis.* The symptoms of pyloric stenosis usually begin during the 3rd week of life but in some instances may be manifested earlier. The classical picture is of projectile vomiting, constipation, visible peristalsis over the upper abdomen and loss of weight with dehydration in the more severe cases. The vomiting occurs soon after feeds, is definitely forceful, white in color and consisting of milk and curds. The stools are hard and dry and passed at intervals of two or three days. Visible peristalsis goes from left to right and, if not present at the initial examination, can be easily stimulated by giving the baby a feed. The hard lump of the thickened pylorus is palpable just to the right of the midline between the umbilicus and the costal margin. Loss of weight is invariable and with marked persistent vomiting, dehydration and alkalosis set in. The treatment of choice is surgery (Rammstedt's operation). In the absence of good surgical care many patients can be successfully treated by giving an antispasmodic drug before each feed. The one most frequently used is atropinemethyl nitrate in a dose of 0.1 mgm increasing to 0.3 mgm if necessary. With medical treatment the response is often slow and gradual and it may take as long as 3 weeks for the vomiting to subside completely. The dehydration and electrolyte imbalance must be treated appropriately.

7. *Torsion of the stomach* is an infrequent entity but should be kept in mind when vomiting occurs in the newborn. It is a

condition where the stomach is rotated 180° to the right so that the greater curvature lies above the lesser and the pylorus and first part of duodenum are stretched so that they lie pointing vertically downwards instead of in the normal horizontal position. Vomiting starts often in the first week or a little later, is projectile and after almost every feed. It closely simulates pyloric stenosis except that as a rule, there is no visible peristalsis. The diagnosis is made by feeding the baby some contrast material and taking x-rays in the antero-posterior and left anterior oblique views in the vertical position. The appearance is quite typical, showing the position of the stomach and duodenum. The treatment is purely postural, and keeping the baby constantly propped up at an angle of about 60° and turned on its right side, the vomiting gradually subsides. It is generally self-limiting and never requires surgery.

8. Gastroenteritis usually starts with vomiting but is soon followed by diarrhoea. It is discussed in the next section.

Diarrhoea in the Newborn

1. *Faulty feeding* can give rise to a frequency of stools. When a child is fed at very frequent intervals, the gastrocolic reflex is repeatedly excited and the baby passes a stool almost every time it is fed. Feeding the baby every time it cries, so-called self demand feeding, often produces this result. The stools are of normal yellow color, loose but not watery, and do not contain mucus. The baby's weight is within normal limits and the condition is soon corrected by advising the mother to give feeds at regular intervals.

If the quantity of milk the baby receives is in excess of its physiologic requirement, it is likely to develop a frequency of stools. In a breast fed infant this is generally a temporary phenomenon in the first two or three weeks of life, until the baby's needs catch up with the flow of milk available. It is often a problem in bottle fed babies where the mother thinks her child is not gaining fast enough, and attempts to do so by giving it too much. Or perhaps she has been instructed to give a certain quantity at each feed, and she forces it in even if the infant is not willing to do so on his own. Here again, the patient's weight is normal or more than average, and the diagnosis lies in obtaining an exact history.

If the type of milk used for a bottle fed baby is high in fat content, it is likely to produce diarrhoea. Therefore if fresh buf-

falo's milk is being used, it is advisable to dilute it 3:1 with water to bring the fat content down from 7 to 5%.

Allergy to milk protein may cause diarrhoea in the unusual case and such children need to be fed with proprietary foods made from soya bean.

2. *Infection.* The commonest cause of diarrhoea in our country is infection. It may occur as an isolated case, or as an epidemic in a newborn nursery. The organisms responsible are varied. Those reported to have been isolated at culture are pyocyanus, proteus, shigella, E. coli, enterococci and viruses. In Bombay city there is a definite seasonal trend, with an increase in the number of cases seen during the monsoon when flies, that carry these infections, abound. Thrush—a monilia albicans infection of the buccal mucosa can sometimes cause a fungal diarrhoea.

The symptoms usually begin with vomiting, loss of appetite, irritability and constant crying, soon followed by the passage of loose, sometimes watery, stools, of a greenish yellow color, which are often expelled with a good deal of flatus. The skin around the anus is inflamed. Severe diarrhoea in the newborn very rapidly leads to dehydration and acidosis. With mild dehydration, the skin is warm and dry, the tongue is dry, and there may be a rise of temperature. With moderate dehydration, the fontanelle appear sunken, eyeballs recede, the skin is dry and inelastic and the urine is scanty. With severe dehydration, all the above signs are accentuated and signs of acidosis (deep sighing respiration and unconsciousness), and peripheral failure, supervene. In a severely ill patient, if the frequency of stools suddenly stops, it is a sign of grave prognosis because it signifies the onset of paralytic ileus. The distension of the abdomen becomes very distressing to the child and is difficult to relieve. It has been thought that it is a result of potassium deficiency.

The treatment consists of combating the infection, correcting fluid and electrolyte imbalance and adjusting the feed.

Of the antibiotics available, a rough guide to their use is as follows:—Orally administered streptomycin in a dose of 200 mgm. every 6 hours is effective in the mild case of diarrhoea seen early in the course of the illness. For a more severe case, or one which has not responded at all to streptomycin after 48 hours, chloromycetin in a dose of 40 mgm./kg. in 24 hours is indicated. For those patients who do not respond to either of these, neomycin sulphate, 35 mgm./kg. will prove effective, but should not be used lightly

because of the danger of forming resistant strains of bacteria. Whichever of these three antibiotics is used, it must be used for five days. Prolonged administration often leads to diarrhoea produced by another organism which now has a chance to flourish. Giving the drug for too short a period invariably leads to a relapse.

It is most important to correct the dehydration as soon as possible. A mild case can be managed on increased oral intake of water, or may require subcutaneous fluids. Most cases of dehydration in the newborn, do need intravenously administered fluids. 5% glucose solution, with $1/6$ th molar sodium lactate given at the rate of 80-100 ml./kg. body weight/24 hours is required. The fluids should be given by slow drip in two or three instalments. Each time before starting the drip the condition of the patient should be assessed to determine whether more or less fluid is required.

If the baby is breast fed it is best that this be continued. At times, it may be helpful to shorten the time of the feed for the first day or two of the illness. Most cases of diarrhoea develop in bottle fed babies. On the first day of the illness it is best to keep the child on boiled water or 5% glucose solution only. Subsequently, a feed high in protein and low in fat and carbohydrate produces the best results. For a patient who is not severely ill, giving his usual feed in a diluted form for 3 or 4 days and gradually bringing back the original reconstitution is adequate. For the more severe cases best results are obtained by giving pure milk protein, in the form of calcium caseinate. As the stools improve, the baby's original feeds can be gradually reintroduced.

A soothing zinc castor oil ointment rapidly clears up the skin irritation around the anus.

Primary Peritonitis of the Newborn. This is not a very common condition, but does occur occasionally. The abdomen is distended, vomiting, loss of appetite, constant crying and irritability is soon followed by toxæmia. It is difficult to distinguish, sometimes, between this condition and distension due to intestinal obstruction of mechanical origin. The infection is carried through the umbilicus or blood stream or the gastrointestinal tract. Instances of fatal peritonitis are occasionally encountered.

CHAPTER 4

HEMOLYTIC DISEASE OF THE NEWBORN

Hemolytic disease of the newborn is a result of iso-immunization. This occurs when an antigen present in the baby stimulates the production of immune antibodies in the mother, and these in turn, when they enter the foetal circulation, produce hemolysis of the foetal red cells. The AB groups and their antibodies were first described by Dienst in 1905. The Rh antigen, its antibody, and the clinical effects they produce became widely known through the work of Levine et al. and Landsteiner and Wiener, in 1940: The Rh antigen was found in 85% of Europeans. The corresponding agglutinin was present in women who had given birth to infants with erythroblastosis fetalis.

There are several varieties of Rh antigen, each of which can stimulate the production of the corresponding antibody when injected into a person who does not have the antigen. The commonest of Rh antigens is known as D, and its antibody is anti-D. These antigens are transmitted from parent to child by the genes. When the gene D is absent from the chromosome, its place is taken by an alternative form (allelomorph) d. The body cells carry pairs of chromosomes, one derived from the mother and one from the father. The sex cells carry only one Rh chromosome. If D is present, d is absent, and similarly with the other types of Rh antigens, C and c, and E and e. With fertilisation of the ovum, the foetus acquires two sets of Rh chromosomes. The sum of the genes present is known as the genotype of the person, e.g., DD, Dd, or dd. The Rh chromosome will contain one of each of the C, D and E types. A DD person is homozygous positive, a Dd person is heterozygous positive and a dd person is rh negative. Various permutations and combinations of these six common Rh antigens are possible. Some authors use different symbols.

Alternate Terminologies in order of Frequency of Occurrence.

Fisher	Weiner
DCe	Rh1 R1
dce	rh r
DcE	Rh2 R2

Dce	Rho	Ro
dCe	rh'	r'
dcE	rh''	r''
DCE	Rh1 Rh2	Rz
dCE	rh' rh''	ry

Rh Antibiotics. These are of two types. The saline agglutinin will agglutinate Rh positive cells suspended in saline. The second type will agglutinate these cells only when suspended in a protein medium like albumin, and will also, when added to these cells, so affect them that when the saline agglutinin is added, no agglutination will occur. This antibody is therefore known as the blocking or incomplete antihody.

The Rh antibody does not occur naturally, but is produced when an Rh negative person is transfused with Rh positive cells, or when an Rh negative woman bears an Rh positive foetus. Transfusion is the more powerful stimulus—taking only 0.06 ml. of blood to stimulate antibody production.

Effect and Detection of Sensitisation during Pregnancy

A pregnancy which terminates in an abortion can also stimulate sensitisation. With each successive pregnancy, the degree of sensitisation increases. In addition to the number of pregnancies there is also some unknown factor involved which determines why some women secrete more antibody with the first pregnancy and others may not produce any even after several pregnancies. It has also been proposed that if the ABO group of mother and child is the same, the chances of Rh sensitisation are higher, whereas if the ABO group is different, the incidence of sensitisation is much lower. Among the white races, where the incidence of Rh negativity is 15%, 1 in 200 pregnancies result in hemolytic disease. When we consider only Rh negative pregnant women, the incidence is 1 in 22, the frequency being 1 in 12 in the 5th pregnancy. At the Nowrosjee Wadia Hospital, the incidence of Rh negativity among our antenatal patients is 5.3%; the incidence of hemolytic disease being 1 in 37.

The possibility of death in an untreated first-affected child of an Rh negative woman, is 1 in 10.

The detection of Rh antibodies in an Rh negative pregnant woman is most important because it is the first indication of pos-

sible foetal damage. Every woman should have her blood group determined at the first antenatal visit, and if found to be Rh negative the Rh antibody titre should be established at that time, and repeated at five and seven months and more frequently thereafter if present, particularly if found to be increasing. A rise in titre may not always be found but an appreciable rise from month to month is of grave significance.

Effects on Foetus. When Rh antibodies enter the foetal circulation, they coat the infant's RBCs and produce destruction of the cells. When this happens to a severe degree in utero the foetus dies in a condition known as hydrops fetalis. Death usually occurs about the 30th to 34th week of pregnancy, although in some cases the foetus may be born alive and die soon after. The foetus is grossly oedematous, very pale, and may be macerated.

In a mild or moderately affected case, the infant is born at term, and may be jaundiced at birth or soon after. Clinical icterus almost always develops within the first 24 hours, and hemolytic disease must always be suspected when jaundice appears this early. Pallor is generally not obvious at birth but develops by the 2nd or 3rd day. The jaundice deepens rapidly and is maximal by the 3rd day. Severe untreated cases develop kernicterus on about the 3rd day with spasticity and convulsions. It is reported that 14% of untreated infants who survive develop kernicterus. Kernicterus, rather than anaemia, is the cause of death.

Bilirubin. Normal cord blood bilirubin is 1 to 2 mgm.%. It rises to 7 mgm.% by the 3rd to 5th day. In hemolytic disease it is over 3 mgm.% and rises rapidly to a peak on the 3rd day reaching values as high as 30 mgm.%. The rate of increase is an important help in determining the treatment, and it should be estimated at intervals of 6 hours in the doubtful case.

Hemoglobin. The normal cord hemoglobin varies from 16 to 20 G.%. In hemolytic disease it is considerably lower. A value over 15 G.% indicates mild involvement and the prognosis should be good. If it is less than 6 G.% the infant is not likely to survive.

Nucleated red cells are seen in the peripheral smear in greater number than the normal of 5 per 100 WBC. The reticulocyte count in these infants varies from 6 to 40%.

Coombs Test. This is a very helpful test in diagnosing hemolytic disease due to Rh incompatibility. A positive test indicates the presence of active hemolysis. It is not always positive in cases of ABO incompatibility in the newborn.

ABO Incompatibility. There is a possibility of hemolytic disease in the newborn in instances of heterospecific pregnancies where the ABO group in mother and child are different. The first born child is often affected, and previous transfusion in the mother does not appear to have as much influence in these instances as in the case of hemolytic disease of Rh origin. The infant is thought to secrete some substance which stimulates antibody production in the mother.

The diagnosis in such a case depends on (1) the demonstration of the possibility of ABO incompatibility to the exclusion of other possible factors; (2) demonstration of alpha or beta agglutinins in high titre in maternal serum (3) the detection of immune agglutinins in maternal serum; (Witebsky test); (4) the presence of hemolysins in maternal sera.

Management. The cord blood must be examined immediately in the case of every infant born to an Rh negative mother. The infant who shows no or only mild evidence of hemolysis needs only to be observed. The indications for exchange transfusion are: (1) Cord hemoglobin less than 14 G%, followed by a rapid fall. (2) Strongly positive Coombs test. (3) Serum bilirubin over 18 mgm.% and even if a cord bilirubin is over 6 mgm. associated with the other findings. A rapidly rising bilirubin is an indication for exchange transfusion to prevent the development of kernicterus. (4) History of moderate or severe hemolytic disease in a previous sibling.

If the tests on the cord blood are borderline, frequent observations at intervals of 6 hours will show whether the hemolysis is progressing rapidly. The cord should be divided as soon as the baby is born without waiting for pulsations to cease.

Kernicterus. The indirect reacting bilirubin circulating in large quantities damages the infant brain, particularly the basal ganglia and the nuclear masses of the brain stem and cerebellum. By about the 3rd day, the patient is markedly jaundiced, drowsy, refuses to take feeds, and develops spasticity, twitchings and convulsions. Death usually occurs by the end of the first week. Infants who survive are mentally and physically retarded.

Research is being conducted in many centres, to study the enzyme systems in the liver which convert the indirect reacting bilirubin into its glucuronide which is excreted by the liver.

CHAPTER 5

MISCELLANEOUS CONDITIONS OF IMPORTANCE IN THE NEWBORN PERIOD

Convulsions

This is an alarming symptom, not infrequently encountered at this stage of life. The causes are:—

1. Intracranial injury can produce twitchings or convulsions that begin on the first or second day. They may be localised or generalised, the frequency and duration varying with the severity of the lesion. The baby is usually unconscious in the interval between convulsions, does not take feeds, may have vomiting, and cries shrilly when awake. The Moro reflex is absent. The respiration is slow, irregular and shallow, resulting in cyanosis.

2. Tetany of the newborn closely resembles intracranial damage. The chief point of differentiation is the low serum calcium. Evidence of neonatal rickets may be present, and the mother is often a multipara with several, rapidly successive pregnancies.

3. Severe hemolytic disease of the newborn produces convulsions and rigidity when the patient develops kernicterus as a result of damage to the basal nuclei by the indirect reacting bilirubin. Neurological symptoms develop on the third or fourth day at the peak of the jaundice. Hematological data give the diagnosis.

4. Meningitis, though rather unusual at this age, nevertheless is occasionally seen. The symptoms usually begin after the third day, with or without fever, and with convulsions, unconsciousness, neck stiffness and bulging fontanelle. Examination of the cerebrospinal fluid gives conclusive evidence. Prompt, appropriate antibiotic therapy must be vigorously instituted to save the child's life. At one time, meningitis in such a young infant had an almost uniformly fatal outcome. To-day, with use of the antibiotic to which the organism is sensitive, the disease can be controlled in 48 hours. As a working rule, Penicillin 200,000 units every 6 hours, and Tetracycline 40 mgm./kg. body weight given in combination produces the best results. Supportive treatment in the form of intragastric feeds and parenteral fluids need careful attention.

5. Tetanus neonatorum still exists in India where many

babies are delivered at home under the most unsanitary conditions. The convulsions associated with generalised rigidity, risus sardonicus and spasm of the jaw, is unmistakable. Serum alone has not been effective in saving any patients. Judicious use of relaxant drugs has helped in some cases. It is a condition with a very grave prognosis, particularly when the symptoms begin during the first week of life.

6. Congenital heart disease in which there is marked pulmonary stenosis or atresia can give rise to convulsions which are of anoxic origin. The patient is markedly cyanosed, has tachycardia and anoxic spells. Clinical, radiologic, and electrocardiographic evidence of heart disease points to the diagnosis.

7. Sepsis anywhere in the body, particularly when associated with fever, can give convulsive seizures. Other signs of infection will be present.

8. Congenital defects of the brain may exhibit many of the symptoms of birth injury, such as inability to take feeds, feeble cry and rigidity. They show no evidence of increased intracranial pressure. The presence of associated malformations may be of value in the diagnosis. The diagnosis can usually be made only after some days, with any degree of certainty, after all other causes are eliminated.

General Treatment of Convulsions. Rest, and absolute quiet are imperative. Handling of the baby must be reduced to a minimum. The baby should be kept warm, but not overheated. If attacks of cyanosis occur, oxygen should be administered. Feeds are best given by gavage. Phenobarbitone 8 mgm. every 6 to 12 hours or sodium seconal 45 mgm. every 6 hours are effective in controlling the frequency and intensity of the convulsions. Intramuscular injection of $\frac{1}{2}$ to 1 ml. of paraldehyde should be used if the convulsions when first seen are very severe. The frequency and dose of these sedatives should be adjusted for the individual patient.

Diseases of Skin

Impetigo. *Staphylococcus aureus* is the usual organism responsible for this common skin infection. The lesions appear any time after the 2nd day. It starts as vesicles on the abdomen, thigh, or any other part of the body. They break quickly, leaving bright, red, denuded skin. It is a highly infectious condition, and should be promptly treated with 1% gentian violet, or an antibiotic oint-

ment. The patient should be isolated from other newborn babies.

Pemphigus appears to be an exaggerated form of impetigo. The lesions become confluent, leaving large denuded areas. Fever, anorexia and symptoms of shock appear. Antibiotics systematically administered are necessary. The prognosis is not good.

Nevi, vascular and pigmented nevi are very frequently seen. Vascular nevi are most frequently seen on the nape of the neck and can also be present over any part of the body. Most of them are areas of pink colouring, commonly known as the port wine stain. By the age of two years most of these disappear. A more swollen hemangioma of small size, the "strawberry mark" is also fairly common and generally needs no treatment. Only large ones that show no sign of receding by the age of 3 years may require x-ray treatment, chemical cautery or surgery.

Pigmented nevi are also fairly common, and most of them fade away spontaneously. Very seldom do they undergo malignant change. The greenish areas of discoloration on the back and buttocks known as mongoloid spots are frequently seen, but clear up by the age of 1 to 2 years, and have no connection with the type of mental deficiency known as mongolism.

Epidermolysis bullosa is characterised by the appearance of small bullae all over the body, particularly on the pressure points. It may be a mild self-limiting condition, but the severe form is often lethal. This type appears through hereditary transmission, as more than one infant may be born with it.

Congenital ichthyosis of various degrees are encountered. Fortunately the very severe form (harlequin foetus) is extremely rare.

Scleroma neonatorum is characterised by a nonedemous waxy hardening of the subcutaneous tissue starting on the legs and rapidly spreading upwards. The condition is associated with subnormal body temperatures, and more often seen in babies with diarrhoea or in premature infants. Before steroid therapy was used, the condition was uniformly fatal. With prompt institution of intramuscular cortisone 12.5 mgm. every 6 to 8 hours, at least 50% of the patients can be expected to survive without suffering any permanent damage.

Infections in the Newborn Period

Infections of the skin, eye, and umbilicus are fairly common and tend to spread in epidemic form in a nursery unless the patient is isolated from the start.

Conjunctivitis produced by the staphylococcus, pneumococcus, or streptococci, present with the same symptoms of redness and pyogenic discharge from the eyes. Local instillation of an antibiotic eye ointment 3 or 4 times a day is necessary as long as the erythema and discharge persist. The ointments give more prompt results than do drops, which tend to get washed away rapidly.

Infection of the umbilicus is a serious matter unless treated promptly. There is at first a thin serous discharge which may later be frankly purulent. The stump and the skin around it is red and inflamed. If unchecked it can spread as an inflammation of the entire abdominal wall, and travel inwards through the umbilical vein and give rise to pyaemic abscesses all over the body, particularly in the lungs. The patient is often jaundiced. Fever may or may not be present. Tetracycline is the drug of choice in a dose of 40 mgm./kg. body weight per day for a week or more. When resistant organisms develop a change of antibiotic becomes necessary.

Respiratory infections are usually found in babies who have been born after difficult labour, and may have aspirated a great deal of mucus and amniotic fluid. Children with intracranial injuries are prone to develop pneumonia. Collapse of a lobe of the lung with pneumonitis often follows regurgitation and inhalation of a feed.

Sepsis neonatorum is a condition where the focus of entry of the organism is not always apparent. Blood culture may yield staphylococcus aureus, pseudomonas or streptococci. The umbilicus may show signs of infection, there may be a history of prolonged labour or maternal infection. Male babies are more often affected. The onset is at any time between the 2nd day and the 4th week. The usual presenting symptoms are fever, distention of the abdomen, jaundice, vomiting and diarrhoea and an erythematous rash. Very frequently there are no symptoms except that the child is not doing well and is not gaining and appears to be going downhill. The course is sometimes rapidly fatal. The prognosis is better in bigger babies and when antibiotic treatment is begun early.

Congenital syphilis is fortunately on the decline. Routine antenatal serological tests should disclose every patient in need of Penicillin treatment. The disease is usually transmitted to the foetus in the last trimester of pregnancy. In the very severely affected patient, the foetus may be born materated. The usual symptoms at this stage of life are skin and bone manifestations. Des-

quamating, erythematous areas appear on the buttocks, around the mouth and on the palms and soles. Epiphysitis produces painful swellings at the ends of long bones. The so-called rat-bitten appearance on x-ray is quite typical. The recommended treatment is crystalline Penicillin 50,000 units every 8 hours for two weeks. With prompt treatment there should be no sequelae.

Differential Diagnosis of Jaundice in the Newborn

1. Hemolytic disease of the newborn exhibits jaundice earliest, within the first 24 hours. Blood examination shows the presence of Rh or ABO incompatibility, with anaemia, and erythroblastemia and a positive Coombs test.

2. Sepsis in the newborn, no matter where localised usually, results in a toxic jaundice. Jaundice disappears with control of the infection.

3. So-called physiological jaundice appears on the 3rd to 5th day, is not usually very intense, is not accompanied by anaemia, and spontaneously regresses by the end of the first week. The general condition of the baby remains good. It is thought to represent possibly a mild form of ABO incompatibility.

4. Congenital atresia of the bile ducts produces an obstructive jaundice, with dark yellow urine and acholic stools. As the condition progresses the liver undergoes cirrhotic changes. The liver is hard and enlarged, and the spleen is also enlarged. Surgery will be effective only if there is a localised obstruction in the common bile duct. Extensive atresia of the intrahepatic ducts is beyond repair.

5. Virus hepatitis is a diagnosis made more or less by excluding any of the above conditions. Occasionally, one may obtain a history of hepatitis in the mother during pregnancy. Liver function in the mother may be impaired. The prognosis is variable, depending on the degree of liver damage. Some cases of infantile cirrhosis are thought to be a sequelae of virus hepatitis in the newborn.

Conditions Requiring Surgical Correction in early Newborn Period

There are certain congenital anomalies that require surgical correction in the newborn if the baby is to survive at all. The important ones are—

1. *Thoracic Emergencies.*

Diaphragmatic hernia. The symptoms of dyspnoea, cyanosis, rapid respiration and frequently vomiting are evident soon after birth. The abdomen does not show its normal fulness and as the condition is more frequently left-sided, there is a mediastinal shift to the right. A plain x-ray of the chest and abdomen confirms the diagnosis. Surgery should be undertaken within the first 48 hours if the mortality is to be reduced.

Oesophageal atresia with tracheoesophageal fistula presents with repeated cyanotic attacks, inability to swallow and collection of sticky mucus and salivary secretion in the pharynx. A rubber catheter passed into the oesophagus meets with an impassable obstruction. If any contrast studies are undertaken, a non-irritating, radio-opaque substance may be used, although it is not necessary for making a diagnosis. Barium should on no account be given to a newborn baby as regurgitation into the bronchial tree is almost invariable and produces collapse of the lobes of the lung and a pneumonitis which is fatal. Early surgery offers the only hope of survival. Babies over 2.5 kg. operated on within 48 hours of birth stand the best chance.

Congenital emphysema or large tension cysts of the lung which produce symptoms in the newborn require urgent surgery to alleviate the respiratory distress. A chest x-ray is an invaluable aid in the diagnosis of respiratory distress, and there should be no delay in taking a film.

There are certain congenital defects of the heart like extreme pulmonic or aortic valve stenosis which result in early death, but which can be corrected if the facilities are available for cardiac surgery.

2. *Abdominal Emergencies.*

Imperforate anus is probably the most common condition among this group. Some cases are simple enough to be corrected by a perineal incision. If there is any doubt about the level of the upper pouch, it might be wiser to do a colostomy initially followed later by corrective repair. The presence of a recto-vesical fistula usually indicates a high upper blind pouch.

Omphalocele is a condition where abdominal contents appear externally at the site of the umbilicus and covered only by peritoneum, without being covered by skin or subcutaneous tissue.

Peritonitis develops very rapidly. Surgery should be performed as soon as possible after birth.

Intestinal obstruction gives the classical picture of constipation with bile-stained vomiting. Distention of the abdomen may not develop till much later. The diagnosis is made obvious on taking a plain x-ray of the abdomen with the patient in the vertical position. The pattern of air and fluid levels to a certain extent gives a clue to the level of the obstruction, although its exact nature may not be evident till laparotomy is performed. Some patients with obstruction develop perforation and pneumoperitoneum. The mortality is still high and early surgery is essential.

Pyloric stenosis usually manifests toward the third week of life. The clinical picture has been discussed in the section on vomiting.

Tumour in the abdomen, e.g. teratoma or congenital ovarian cysts, may be large enough to be evident at birth and should be removed soon to avoid spread of a possible malignancy.

3. Neurological emergencies.

A depressed fracture of the skull obviously needs operative intervention to relieve the pressure on the brain. This condition is fortunately rare.

Meningoceles which have no skin covering need early operation to avoid the complication of meningitis. The results are good when there is no paraplegia. Extensive nerve involvement condemns the patient for life.

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Its chief advantages are that it is technically an easy procedure to practise and the obstetrician is independent of the presence of a trained anaesthetist. It gives good perineal relaxation, does not affect the foetus, and it can be safely given to a patient without any premedication and even on a full stomach.

To be able to give the pudendal block anaesthesia successfully, it is necessary to know the anatomy and the anatomic relationship of the pudendal nerve. The pudendal nerve is derived from the branches of the second, third and fourth anterior sacral nerves which join into a single trunk, $\frac{1}{2}$ to 1 cm. proximal to the ischial spine. It passes out of the pelvis through the greater sciatic foramen, inferior to the piriformis muscle. It passes posterior to the ischial spine between the sacrospinous ligament anteriorly and the sacrotuberous ligament posteriorly. It re-enters the pelvis through the lesser sciatic foramen and enters the pudendal canal at the inferior tip of the ischial spine.

The pudendal nerve trunk divides into three main branches: (1) the inferior haemorrhoidal, (2) the perineal, and (3) the dorsal nerve to the clitoris. Each of these is an important sensory nerve of the perineum. The *inferior haemorrhoidal* nerve supplies the lower rectum, the sphincter ani externus, and the skin anterior and posterior to the anus. The *perineal* branch is the largest and is the sensory nerve to the vulva and the perineum, and also supplies the superficial and the deep muscles and the perineum. The *dorsal nerve of the clitoris* supplies the region of the clitoris.

Technique. Twenty c.c. of 1 per cent novocaine solution is used to inject around the main trunk through a 5 inch long needle. The needle is inserted through the skin of the perineum between the ischial tuberosity and the anus, somewhat nearer to the anus than the tuberosity. The needle is directed through the ischiorectal fossa toward the posterior surface of the ischial spine. The needle is guided to the tip of the ischial spine by a finger in the vagina. As the needle point approaches the ischial spine, it is pushed towards it by the directing finger. When the needle is properly placed in the pudendal canal, free from the ligaments and the obturator muscle, it can be pulled back and forth without resistance. If there is resistance to its further introduction, it should be withdrawn to 3 to 4 cm. and reinserted. Ten c.c. are injected posterior to the ischial spine in approximately three equal parts. The needle is inserted a little further to the superior tip, and 3 c.c. are injected. The needle is inserted still further into the greater sciatic notch

and 4 c.c. are injected. The needle is gradually withdrawn and the remaining 3 c.c. are injected beneath the inferior tip of the spine.

When the injection is properly given, there is loss of perineal sensation as well as muscular relaxation within 3 minutes. Many operators inject a few c.c.s beneath the perineal and vulval skin in addition to the blocking of the main trunk, so as to ensure a complete loss of sensation of the perineum.

Trichloroethylene (Trilene). The great advantage of trilene is that the patient can administer it herself at the time of uterine contractions. The patient holds the inhaler and breathes the vapour deeply before the peak of a pain so that she cooperates well in the bearing down efforts. Trilene does not affect uterine contractions and therefore does not prolong labour. It only produces analgesia and the patient remains conscious throughout the second stage (Fig. 149).

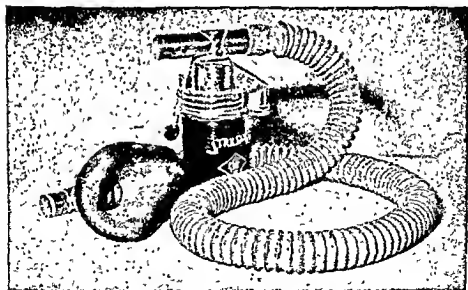


Fig. 149. Apparatus for trilene anaesthesia.

To be able to use it advantageously, the patient should be given practice during the last weeks of pregnancy. Without this previous knowledge of inhaling the vapour and its effects, many patients during the agitated mental state of labour, fail to inhale the vapour properly.

Local Infiltration of Abdominal Wall. It is the most valuable

method of administering anaesthesia for abdominal obstetric operations. It is a perfectly safe form of anaesthesia for the mother as well as for the foetus. Local infiltration can be carried out by the obstetrician himself. It does not need any preoperative preparation, and can be administered even when the mother has had a meal a short while previously. It is most suitable in patients in circulatory collapse from blood loss, or who are in a state of shock.

Technique. To make the patient almost oblivious to her surroundings, 100 mg. pethidine is given an hour before the operation. If the operation is an emergency measure, 25 mg. pethidine is given intravenously, very slowly, on the operation table.

The local anaesthetic used is 1 per cent novocaine, cevicaïne or xylocaine. To 150 c.c. of the solution, 0.5 c.c. of 1 in 1000 adrenaline is added. The skin and the subcutaneous tissues, the rectus sheath and the rectus muscle, and finally the peritoneum, are injected separately (Fig. 150).

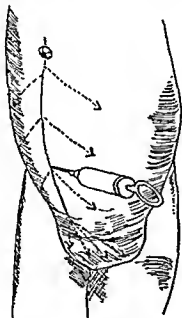


Fig 150. Infiltration of abdominal wall.

With a 5 inch long needle, the skin and the subcutaneous tissues are infiltrated by commencing the injection midway between the umbilicus and the symphysis pubis. The solution is injected upwards upto and just beyond the umbilicus, and downward upto

the mon pubis. The injection is not only in the middle line but fanwise, for a distance of 1-2 inches on either side of the midline. After waiting for a couple of minutes for the region to be properly anaesthetised, the skin and the subcutaneous tissues are incised upto the rectus sheath.

A fresh needle is taken, and about 2 c.c. of the solution is injected through the rectus sheath into the rectus muscle at five or six places on either side. The sheath is then incised, and the recti-muscles are separated.

The parietal peritoneum is then incised. The abdominal wall is lifted forward by the index and the middle fingers of the left hand and, as was done for the rectus sheath, 2 c.c. of the solution is injected subperitoneally as far out as possible at several places on either side of the incised peritoneum. Now the patient does not feel the retraction of the abdominal wall.

Before cutting the utero-vesical reflection of the peritoneum, some operators inject a few c.c. of the solution between the peritoneum and the uterine wall.

Spinal Anaesthesia. There is no doubt that spinal anaesthesia carries greater risk in the pregnant woman than at other times, but nowadays, with proper technique, there is practically no danger when spinal anaesthesia is given. In obstetrics, spinal anaesthesia is, in several respects, superior to any form of inhalation anaesthesia.

Spinal anaesthesia can be given without any preoperative preparation of the patient. It can be safely given when the patient has had a meal a short time before, because even if vomiting occurs after giving the spinal, there is no danger of vomited material being inhaled, as the patient is conscious. When vomiting occurs after inhalation anaesthesia, there is great danger of post-operative pulmonary complications following inhalation of vomitus.

Under spinal anaesthesia, the uterus firmly contracts and retracts immediately after the delivery of the foetus and blood loss is considerably less than that after inhalation anaesthesia. This is a valuable advantage, both to the patient and the obstetrician.

With spinal anaesthesia there is no anoxia, and the foetus cries immediately, in contrast to inhalation anaesthesia, where there is usually a time lag of several minutes before respiration is established. Besides, as the mother is conscious she has the psychological satisfaction of hearing her infant cry as during a spontaneous vaginal delivery.

Yet another advantage of spinal anaesthesia is that it can be administered by the obstetrician himself in outlying areas where the services of a trained anaesthetist are not available. But it must be stressed that herein lies the grave danger of sudden precipitous fall of blood pressure if the patient is not watched after giving the spinal anaesthesia. Usually, the fall in blood pressure occurs within the first few minutes, but the pressure may fall dangerously any time within the first hour and a half of giving the spinal injection. A great percentage of deaths following spinal anaesthesia are when the obstetrician, immediately after giving the spinal injection, commences the operation himself, without leaving the patient in charge of some trained person.

Contraindications. (1) If the blood pressure is below 100 mm. systolic, spinal anaesthesia is contraindicated. (2) When severe antepartum or intrapartum haemorrhage has occurred, spinal anaesthesia should not be considered. (3) Spinal anaesthesia is contraindicated in severely anaemic women. (4) Hypertension associated with myocardial damage; congestive cardiac failure; coronary disease. (5) In presence of obstetric shock, spinal anaesthesia is out of question. (6) Skin infection. (7) Deformed spine. (8) Patient wanting to remain unconscious.

Preoperative Medication and Precautions

(1) An injection of 0.6 mgm. Atropine sulphate is given 45 minutes before the operation.

(2) Intravenous drip of 5% glucose solution must be kept ready beforehand, so that it can be started immediately after spinal injection, and not after allowing the blood pressure to fall, thus exposing the foetus to dangerous hypoxia.

(3) Facilities must be provided to give cent per cent oxygen, either with bag and mask or when necessary through an intra-tracheal tube.

(4) Vasopressor drugs must be ready at hand. The commonly used drugs are vasoxine (Methoxamine) 5-10 mg., Mephentine (Mephenteramine) 10-20 mg., methedrine, 5-10 mg.

(5) Occasionally spinal anaesthesia fails, and facilities for giving general anaesthesia should be available.

(6) All requisites for resuscitating the infant should be kept ready.

Technique. Lumbar puncture can be done either in sitting

or lying down position and it is simply a matter of the individual anaesthetist getting used to a particular position. However, in very fat subjects the sitting position is more suitable.

In lying down position the patient is put in the left lateral position. An assistant is asked to flex the lower extremities sharply at the knees and hips and the neck is flexed. By sharply flexing the spine the intervertebral spaces are opened up.

The skin in the region of the spine is prepared by ether. The skin and the soft tissues are anaesthetised and then a 22 or 24 gauge lumbar puncture needle is inserted either in the space between the 3rd and 4th or 4th and 5th lumbar vertebrae.

The drugs commonly used for spinal anaesthesia are: Nupercaine, or xylocaine. In obstetrics 0.8 to 1 c.c. is sufficient (lignocaine).

During the uterine contractions the pressure in the cerebrospinal fluid is raised and waves are set up which may force the anaesthesia to a dangerously high level. Care should therefore be taken not to inject the anaesthetic agent during a contraction.

After giving the injection, the patient is immediately and carefully turned on her back and oxygen is given either intranasally or by a bag and mask. Five per cent glucose drip is started at once and blood pressure is frequently recorded.

If the blood pressure falls by more than 25 mm. Hg. the glucose drip should be made to run rapidly and above mentioned vasopressor drugs should be injected intravenously.

Foetal bradycardia often occurs when the maternal blood pressure falls to 80 mm. Hg. systolic but may occur even when the pressure is 100 mm. Hg. systolic. Sudden severe hypotension is likely to cause severe foetal hypoxia and death.

The effects of moderate degrees of hypotension may not be reflected in the perinatal mortality, but damage to the central nervous system may lead to serious consequences when the child grows

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CHAPTER 2

CAESAREAN SECTION.

Perhaps the most notable change in present-day obstetric practice is the increase in the acceptable indications for performing caesarean section. The free availability of blood transfusions, the introduction of antibiotics, and the improvements in the administration of anaesthesia, have contributed towards making caesarean section a safe operation even when it is performed in cases of delayed, obstructed labour.

At the Nowrosjee Wadia Maternity Hospital about 80 per cent are lower segment caesarean sections, and the remaining are classical. The figure for classical operation appears to be relatively high for a modern obstetric institution, but in the majority of cases the classical operation is selected only because sterilization forms a part of the operation.

Incidence. The caesarean rate varies from institution to institution but, as a result of the greater number of indications for a caesarean in present day obstetrics, the incidence of caesarean section has increased in all countries. The figures of N.W.M. Hospital, Bombay, during the two 5 year periods clearly show the rising incidence of caesarean section. During the 5 year period 1954-1958 there were 43,842 confinements and 667 caesarean sections giving an incidence of 1.5 per cent. During the 5 year period 1959-1963 there were 47,886 confinements and 1,087 caesarean sections giving an incidence of 2.2 per cent. Krishna Menon from Madras gave an incidence of 2.1 per cent in the period between 1954-1961. At Queen Charlotte's Hospital, the caesarean section rate in the ten years' period, 1945-54, was 3.3 per cent while the Liverpool Hospital reported a 15% caesarean section rate in 1950. In the John Hopkins Hospital, during the years 1946-53, an incidence of 5% in 21,050 deliveries was reported by Eastman. Thus, it is evident that the difference in the rate is dependent on the experience and the conservative or radical tendency of the Visiting Staff. The low section rate at the Nowrosjee Wadia Maternity Hospital is partly due to the fact that no caesarean section operation is done without the permission of a senior member of the Visiting

Staff, and, also, partly due to a large number of emergency admissions where the odds are against the baby.

Indication for Caesarean Section

Cephalopelvic Disproportion. Cephalopelvic disproportion forms the largest group in all reported series of cases. It includes cases of (1) grossly contracted pelvis, (2) a pelvis of normal shape in which some of the diameters are small, (3) a pelvis of normal shape and size but the foetus is disproportionately large, and (4) occipito posterior positions. Some writers also include cases of abnormal uterine action in this group, but it is discussed here separately. There can be no disagreement about abdominal delivery in cases of major degrees of disproportion or grossly deformed pelvis. Minor degrees of disproportion are subjected to caesarean section only after a trial of labour has been unsuccessful.

In cases of disproportion, the object of a timely caesarean section is to avoid a difficult vaginal delivery resulting in stillbirth, or the birth of a live baby which succumbs to intracranial trauma.

Malpresentations. Brow. All cases of persistent brow presentation at or above the mid-pelvic plane are best delivered by caesarean section. At the N.W.M. Hospital, Bombay, there were 6 cases of persistent brow presentation during the year 1961, and caesarean section was done in 5 cases.

Face. Spontaneous delivery is the rule in mento-anterior cases. Most mento-posterior presentations undergo rotation into the mento-anterior position and a caesarean section is therefore rarely required for face presentations.

Breech. In only a few cases of breech presentation, a caesarean section is indicated. Breech in an elderly primipara, or breech in a case of bad obstetric history, or breech in a case of contracted pelvis is subjected to caesarean section. At the N.W.M. Hospital, there were 507 cases of breech presentation during 1960-61, and only 11 cases were delivered by caesarean section.

Neglected Transverse Lie. Until recently, a neglected transverse lie was managed by decapitation, but, the overstretched lower uterine segment frequently ruptured in the process. This still remains the practice in outlying areas of India, but in large maternity institutions such cases are generally treated by a caesarean section.

As the lower segment is greatly stretched laterally, there is often difficulty in extracting the foetus through a transverse lower segment incision. A vertical incision into the lower segment is not desirable as there is the danger of extension downwards into the vaginal vault, with trauma to the bladder. Therefore, a vertical incision into the lower part of the body is performed.

Cord Presentation and Cord Prolapse. For obtaining a live child, all cases of cord presentation and cord prolapse, at or near full term, when the cervix is less than three-fourths dilated, are best submitted to an immediate caesarean section. During 1961, there were 59 cases of cord presentation and cord prolapse, of which 39 were emergency admissions in which the foetus was already dead. Of the 20 registered cases, 10 cases were delivered by caesarean section.

Previous Bad Obstetric History. Majority of cases of previous bad obstetric history have cephalopelvic disproportion as the underlying recurrent cause. An X-ray pelvimetry during pregnancy is an invaluable guide in arriving at a decision for an abdominal or a vaginal delivery.

Abnormal Uterine Action. Hypotonic uterine action is nowadays successfully treated by an oxytocic drip, and unless there is cephalopelvic disproportion, a caesarean section is seldom necessary.

Hypertonic uterine inertia prolongs the first stage of labour and the constant pain exhausts the patient. It does not respond to pitocin drip and needs heavy sedation. Foetal mortality in this type of uterine action rises when labour is prolonged for more than 24 hours.

Cervical rigidity may be functional or organic. In functional rigidity the cervix frequently dilates slowly, but there are cases in which the cervix dilates partially and remains so for a long time, and caesarean section is indicated. For organic rigidity, as a result of fibrosis, caesarean section is the only mode of delivery.

Previous Caesarean Section. The adage "once a caesarean always a caesarean" was true in the past when the only indication for caesarean section was a badly deformed pelvis through which vaginal delivery was impossible. At the present time, half or even more than half the cases of previous caesarean section are delivered vaginally, depending on the nature of the indication of the previous caesarean section. Cephalopelvic disproportion will frequently require a repeat caesarean section, while vaginal delivery

can be expected when the previous operation was for placenta praevia, cord prolapse, or a like non-recurrent indication.

Placenta Praevia. In recent years more and more cases of placenta praevia are submitted to caesarean section. All the cases of 3rd and 4th degree and second degree posterior placenta praevia are delivered by caesarean section. In the N.W.M. Hospital out of 128 cases, 45, 35 per cent were delivered by caesarean section. In some institutions the caesarean section rate is as high as 70-80 per cent.

Accidental Haemorrhage. Very few cases of concealed accidental haemorrhage are nowadays submitted to caesarean section. That is because an oxytocic drip usually succeeds in stimulating uterine contractions. In order to prevent hypofibrinogenaemia resulting from absorption of thromboplastin from the retroplacental clot the membranes must be ruptured before starting the oxytocic drip. At the N.W.M. Hospital, there were 175 cases of accidental haemorrhage during the two years, 1960-61, and only 3 cases were submitted to caesarean section.

Toxaemia. In fulminating pre-eclampsia, pregnancy should be terminated as soon as possible before eclampsia supervenes. The usual methods of inducing labour take as long as 24 to 72 hours and should eclampsia supervene during this waiting period, opportune time for caesarean section is lost. Termination by caesarean section is particularly indicated in primigravidae with a closed cervix.

Eclampsia. In most cases of eclampsia, labour starts spontaneously, but there are two categories of cases where a caesarean section is preferable: (1) when eclamptic fits are not controlled within 8-10 hours and the cervix is unripe, and (2) when spontaneous labour does not occur in a primigravidae whose fits have been controlled.

Maternal Diseases. Diabetes. The three recognised clinical complications in diabetic women—intrauterine death, over-weight babies and frequent association of toxaemia—contribute towards the high perinatal loss in this condition. The present trend of performing elective caesarean section after the 36th week is mainly to reduce the perinatal loss. The close liaison between the clinician and the obstetrician has, by proper control of diabetes, considerably lowered the operative mortality following caesarean section. Vaginal delivery is permissible in only those cases where the

previous obstetric history is good, the baby is considered to be of average size, and toxæmia is not a complicating factor.

Cardiac Disease. Unless there is an obstetric indication for resorting to caesarean section in all cases of cardiac disease, a vaginal delivery is allowed.

Tumours Obstructing Vaginal Delivery. The majority of fibromyomata develop in the body of the uterus and do not obstruct labour. Caesarean section is required in an occasional case in which the growth is impacted in the pelvic cavity.

A caesarean section for an ovarian cyst lying below the presenting part has two-fold object. It forms a safe mode of delivery, and at the same time the ovarian cyst can be excised.

In carcinoma of the cervix, a caesarean section is the only mode of delivery, irrespective of the stage of malignancy.

Miscellaneous. Apart from the above discussed indications, caesarean section is necessitated by the undermentioned conditions.

(1) After a successful repair of a *vesico vaginal fistula*, a vaginal delivery is likely to undo the repair, and a caesarean section in subsequent deliveries is advisable.

(2) *Extensive Fibrosis of Vagina.* Severe scarring of the vaginal canal is usually due to a previous badly managed vaginal delivery. When a cartilaginous annular constriction ring through which even a finger cannot be passed is formed in the vagina, abdominal section is an absolute indication.

(3) *Postmaturity.* It is difficult to define postmaturity but when pregnancy has extended to more than 295 days, and induction by oxytocic drip has been unsuccessful, a caesarean section must be considered, in order to prevent intrauterine death of the foetus from anoxia.

(4) *Habitual Intrauterine Death Late in Pregnancy.* In a case of this nature the obstetrician should take the opportunity of performing an elective caesarean section before the term when intrauterine death had occurred in previous pregnancies. Though this appears to be logical, it is not often practicable. Rh or ABO blood incompatibility may be the cause of intrauterine death in some of these cases.

Indications for Classical Caesarean Section

Difficulty of Access to Lower Segment. At times, as a result of a previous caesarean section, or any other operation, dense

adhesions are formed making access to the lower segment difficult and hazardous, a classical incision is then preferred.

Fibromyomata. Multiple growths studded over the anterior surface of the lower segment prevent incision into the lower segment and a classical incision has to be resorted to.

Deformed Pelvis. Occasionally, the pelvis is so deformed that access to the lower segment operation is difficult, and a classical incision is chosen.

Repeat Caesarean Section with Sterilization. When the patient is to be sterilized, a classical incision is sometimes chosen.

Classical Caesarean Section

Abdominal Incision. In the days when classical caesarean section was prevalent, the abdominal incision was paramedian, two-thirds being below the umbilicus and one-third above. Today, the abdominal incision is midline subumbilical as for the lower segment. Therefore it is not possible now, as it was in the former days, to know whether the previous operation was classical or otherwise by merely observing the position of the scar. Some obstetricians prefer a transverse incision for lower segment caesarean section (Fig. 151).

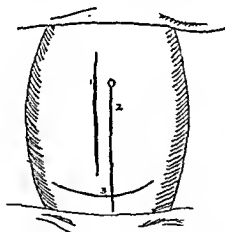


Fig. 151. Incisions employed for caesarean section.

After opening the peritoneal cavity, the first thing is to ascertain the uterine axis. When the axis is vertical, the adnexa and the round ligaments are situated far laterally. If the uterus has rotated to one side, then the adnexa and the round ligament of

the opposite side are seen to come forward medially. Before proceeding further the uterine axis should be manually corrected and the centre of the anterior surface of the uterus brought under abdominal incision. The intestines are packed by wet abdominal towels and Doyen's retractors are placed at the upper and lower angles of the abdominal incision.

Uterine Incision. It is median longitudinal along the anterior uterine wall. It should be five to six inches in length so that the child can be easily extracted (Fig. 152). When the incision is not

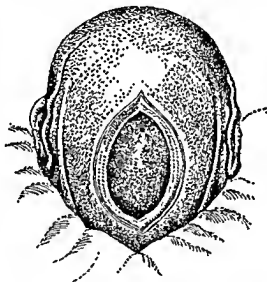


Fig. 152. Vertical incision of uterus with membranes intact.

liberal, not only is it difficult to extract the child but also there is the risk of extension of the incision into the lower segment. A small incision is first made, which is deepened until the cavity is opened, and the incision is quickly enlarged by cutting upwards and downwards with a pair of scissors.

The membranes are then ruptured if they have not already ruptured. When the placenta is situated anteriorly, it will come underneath the incision. If the placental edge can be reached, it is drawn laterally to expose the membranes which are then ruptured. But when the placental margin cannot be reached, the placenta is quickly perforated by the fingers in order to enter the cavity. Bleeding from the large sinuses will be profuse and unless the baby is quickly extracted it will be born deeply asphyxiated.

Extraction of Child. This is best accomplished in cephalic presentation by seizing one or both the feet and pulling the foetus out. There is usually no difficulty in delivering the head but, sometimes, especially when spinal anaesthesia has been given, the neck is gripped by the contracted edges and gentleness and deliberation are necessary in extracting the head. Even in breech presentation, the head is seldom in the line of the incision and usually the baby is delivered by traction on the legs.

The body of the uterus firmly contracts after the expulsion of the foetus. Five units of pitocin intramuscularly and 0.25 mg. of ergometrine intravenously are given as a routine.

The placenta usually separates within a minute after the expulsion of the body and is removed with the entire membranes.

In an elective caesarean operation on a primigravida, it is preferable to pass No. 6 Fenton's dilator through the cervical canal to ensure proper draining of the lochia.

Closure of Uterine Wound. The uterine incision is sutured in three layers:

(1) A continuous No. 1 chromic catgut suture is applied to the deeper part of the uterine muscle avoiding the decidua (Fig. 153).

(2) The second layer approximates the remaining portion of the uterine musculature. A continuous suture of No. 1 chromic catgut is applied. Alternatively interrupted sutures at 1 cm. distance are inserted (Fig. 154).

(3) The third layer is of continuous No. 0 chromic catgut which includes the most superficial layer of the myometrium and the peritoneum.

Finally, the abdomen is closed in layers.

Lower Segment Caesarean Section

Abdominal incision is midline subumbilical. The peritoneum is opened at a point near the upper angle of the wound. This precaution is necessary because the bladder is frequently raised with the lower uterine segment particularly when the operation is performed after many hours of labour. The incision is continued first upwards and then downwards, care being taken not to incise the bladder. The position of the bladder can be made out by the thick white appearance in contrast to the thin shiny peritoneum. Frequently, a network of blood vessels of the elevated base can be

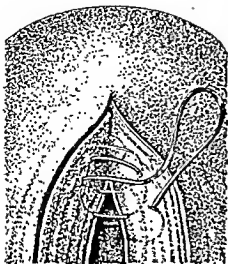


Fig. 153. Suturing of the deeper part of the uterine muscle

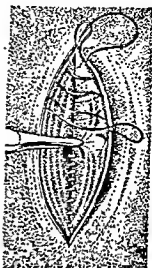


Fig. 154. Suturing of the remaining portion of the uterine muscle.

seen. On opening the abdomen, a varying quantity of peritoneal fluid, at times blood-stained, is found. Normally, the intestines are not visible, but when the operation is performed late in labour, the distended coils may protrude out of the incision.

The next thing to observe is whether there is partial rotation of the uterus. Normally, the uterine blood vessels are situated far laterally but, when the uterus is rotated, the uterine blood vessels of the opposite side are visible in the antero-lateral position. If there is any rotation, it is corrected by passing a hand between the abdominal wall and the body of the uterus.

The field of operation is isolated by wet packs inserted on each side of the uterus. A wide Doyen's blade retracts the lower angle of the incision.

The loose peritoneum covering the anterior surface of the lower uterine segment, about $1\frac{1}{2}$ to 2 inches above the margin of the bladder, is picked up in a dissecting forceps and opened with a snip of the scissors. Through this small incision, closed blades of the scissors are passed on either side raising the peritoneum from the underlying uterine muscle. The peritoneum is cut as far as the lateral borders of the uterus.

The upper edge of the peritoneum is pushed upwards for about

3 cm. The lower edge should not be pushed down for more than 1-2 cm, because the veins at the base of the bladder are likely to be damaged. If any veins are torn they should be caught and ligatured immediately as otherwise there is unnecessary loss of blood during operation. The Doyen's retractor is re-adjusted to include the bladder under its blade.

The position of the head and the shoulder is next palpated to select the site of incision on the lower segment. Sometimes, large sinuses are seen running across the lower segment, and those that cross the line of incision are preferably ligated by under-running sutures.

Uterine Incision. An incision, not more than 1 inch in length, is made in the lower segment by strokes of knife and deepened until the membranes protrude or, if the membranes have ruptured, the head or the shoulders are seen. The edges are held by Morrison's forceps and the incision is extended laterally with a slight upward curve by a pair of scissors. Alternatively, the incision is widened by putting the index fingers of each hand into the small opening and stretching the muscles apart (Fig. 155). Should

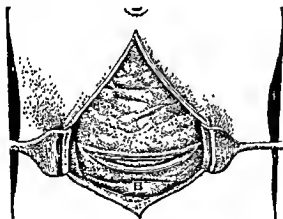


Fig. 155. Transverse incision over the lower segment of the uterus.

the membranes be still intact, they are ruptured and the flow of liquor amnii is sucked out by suction.

Delivery of Head. When the head is altogether above the brim, there is not much difficulty in getting it out. The head may be lying transversely or with the occiput posteriorly or anteriorly. When the head is lying transversely, the fingers of the right hand are inserted between the head and the uterine wall and the head

is laterally flexed to bring it out of the incision. Similarly, a head in the occipito-posterior position is delivered by flexing the head. When the head is in the occipito-anterior position, the head is pushed upward by the fingers until it is raised upto the level of the incision and it is then delivered out of the incision by extension of the head. During delivery of the head, moderate pressure on the fundus is applied through the abdominal wall to assist the delivery.

When the head has gone into the brim of the pelvis, the ease or difficulty with which the head can be extracted depends on the quantity of liquor present and the tone of the uterus. In most cases, the manoeuvres described above are sufficient to deliver the head. Alternatively, the vectis or a blade of forceps is passed below the head and the head is levered out from the pelvis into the uterine incision. Leverage by Willet's forceps is likely to cause laceration of the scalp.

When the head is deeply engaged and the labour has been considerably prolonged, the head cannot be delivered by the above manoeuvres. The less experienced would consider a classical segment as the best way of getting out of the difficulty. One of the following two methods is usually successful in delivering the deeply wedged head. One way is to ask an assistant to push the head upwards out of the pelvis with his hand in the vagina. The other method is that described by Patwardhan. This consists in incising the uterus at the level of the anterior shoulder and delivering the anterior shoulder with the anterior arm. If the back is anterior, the posterior shoulder is rotated forwards and delivered through the incision. By traction on the two arm pits, coupled with fundal pressure, the trunk breech and the lower limbs are delivered. The head is now lifted out of the pelvis by traction on the legs. If the back is posterior, after delivery of the anterior shoulder, two fingers are introduced in the uterus and a foot is sought. Now by traction on the foot, coupled with fundal pressure, the breech followed by the trunk is delivered. The head is delivered by traction on the legs.

After delivering the head, the body should not be immediately delivered. The slight delay is utilised in cleaning the throat and wiping the eyes. By this way, time is given for the uterus to contract and the amount of blood loss following the delivery of the child is reduced. Pitocin, 5 units, intramuscularly and 0.25 mg. of ergometrine intravenously are routinely given.

The upper edge of the incision is caught by Morrison's forceps.

The lower uterine flap is thin, flaccid and recedes deeply into the pelvis, and should be carefully identified and pulled up by Morrison's forceps. No sooner the lower edge is pulled up, the oozing from the wound diminishes considerably.

The placenta takes time to separate and haste is unnecessary. Immediate manual separation is unwarranted and will positively increase the amount of blood loss. The placenta generally separates within a couple of minutes. If it does not do so until one-third of the incision is sutured, it is expressed by pressure on the fundus through the abdominal wall. It may, at times, be necessary to manually separate the placenta. The placenta with the membranes is removed.

Closure of Uterine Incision. The upper edge of the incision is usually thicker than the lower edge and approximation of the two needs care and technique. It is wise to put a suture at either corner of the incision. These act as traction sutures.

(1) The first layer is sutured with No. 1 chromic catgut continuous suture or interrupted sutures are applied at a distance of 1 cm. The needle goes through the entire thickness of the lower edge and through a little more than the deeper half of the upper edge (Fig. 156).

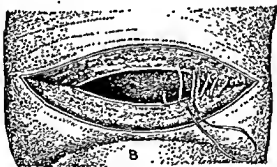


Fig. 156. First layer of continuous sutures.

(2) The second layer is also of No. 1 chromic catgut and takes a bite of the muscle of the lower segment beyond the suture line and the remaining superficial part of the upper segment. There is individual preference for having the second line of suture either as a continuous or a continuous locked stitch. Our preference is for a continuous suture. A locked stitch gives good immediate haemostasis but is likely to weaken the healing by devitalising the muscle in between the lockings (Fig. 157).

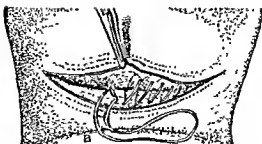


Fig. 157. Second layer of continuous sutures.

(3) The *third* line of suture takes the cut utero-vesical peritoneum. The centre of the vesical flap is raised into the wound with a pair of Allis' forceps. Care is taken to remove any clots of blood from the retro-vesical space. The third line of suture is a continuous suture of No. 0 chromic catgut (Fig. 158).

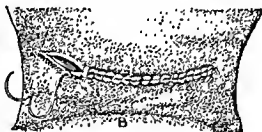


Fig. 158. Suturing of utero-vesicle peritoneum.

The abdominal packs are removed. Blood and liquor, which have collected in the abdominal cavity, are removed by suction and sponges.

Finally, the abdomen is closed in layers.

Extraperitoneal Lower Segment Caesarean Section

This operation was advocated to circumvent peritoneal infection following caesarean delivery. The lower segment is exposed by pushing the bladder and the vesico-uterine fold of peritoneum to one side. The lower segment is thus approached and incised without opening the peritoneal cavity. This operation is technically difficult as compared to the transperitoneal operation. In view of the surgical asepsis in modern obstetrics and the reliable antibiotics of today, this operation has hardly any place.

Complications during Operation

(1) **Injury to Bladder.** The bladder may be injured in one of the following ways:

(a) In the case of prolonged labour, the bladder is usually raised up in the abdomen and is likely to be injured whilst incising the parietal peritoneum.

(b) The bladder which is elevated by the excessive distension of the lower uterine segment may be mistaken for the reflexion of the utero-vesical peritoneum and inadvertently incised.

(c) During extraction of a large head or one which is deeply engaged, the lower uterine segment may tear downwards into the vagina tearing with it the base of the bladder.

(d) If care is not exercised, bladder may be included in the sutures closing the uterine incision.

(2) **Excessive Bleeding.** This may occur in several ways:

(1) **Tearing of uterine blood vessels.** (a) If the rotation of the uterus is not corrected, the more anteriorly situated uterine blood vessels are likely to be torn whilst making a transverse incision.

(b) Similarly, during a difficult extraction of the head, the transverse incision may extend laterally, tearing the uterine vessels.

(2) **Bleeding from placental bed.** (a) Oozing from the placental bed, in case of placenta praevia, is likely to be excessive and, at times, it is necessary to pack the uterine cavity.

(b) When the placenta is separated immediately after the delivery of the foetus, before the uterus has had time to retract, blood loss is likely to be excessive.

(c) Haemorrhage is likely to be excessive after the separation of a placenta which is attached over a deep intramural fibroid.

(d) In accidental haemorrhage, the uterus often fails to contract and retract after the extraction of the foetus and the placenta. Also, should there be associated hypofibrinogenaemia, uncontrollable bleeding will occur.

(e) When caesarean section is performed before the onset of labour, bleeding from the placental bed is, at times, excessive because the uterus does not contract and retract as efficiently as in those cases where the operation is performed during labour.

(f) **Bleeding due to anaesthesia.** During inhalation anaes-

thetia, uterus fails to contract and retract in the normal way, particularly when the anaesthesia is deep.

(g) Suturing the upper edge of the wound to the posterior wall the uterus. The lower edge continues to bleed as long as it is left unsutured.

(3) Injuries to Infant. Whilst opening the uterus, the scalp or ear lobe may be accidentally injured. Fracture of the humerus may occur while hooking out an arm.

(4) Air Embolism. Suction of air through the open mouth of a vessel may cause an air embolism.

(5) Inversion of the uterus. During attempts to remove the placenta by cord traction, the atonic uterus may suddenly get inverted through the lower segment incision.

(6) Foetal Asphyxia. Foetal asphyxia may result from (a) improper oxygenation during anaesthesia, (b) accidental cutting of the cord while incising the uterus, (c) excessive blood loss from incision of a placenta lying over the incision, and (d) delay in delivering the foetus.

Complication After Caesarean Section

(1) Post-operative Bleeding. This may result from the placental site, particularly in cases of placenta praevia, atonicity of the uterus, especially after inhalation anaesthesia or failure to effect complete haemostasis of the uterine incision whilst suturing.

(2) Vesico-vaginal Fistula. Laceration of the bladder, which escapes recognition at the time of operation, results in cervico-vaginal or vesico-vaginal fistula.

(3) Haematoma. (a) Haematoma of the broad ligament due to injury to the vessels near the lateral angle of the incision. It causes persistent low fever with pain and tenderness in the iliac fossa.

(b) Retrovesical haematoma due to injury to one or more of the large veins on the bladder bed or from failure to secure complete haemostasis during suturing the uterine incision.

(4) Wound Infection. In majority of cases it involves a small portion from which purulent discharge exudes. Sometimes, the whole length may suppurate.

(5) Uterine Infection. When caesarean section is done after a prolonged labour, infection of the uterus, is likely.

(6) Retention of Lochia. Sometimes after delivery, usually

in primiparae where elective caesarean section is done, lochia is retained. Faulty suturing of the raised posterior wall of the uterus with the incision will also cause retention of lochia.

(7) Pyometra of uterus results when retained lochia gets infected.

(8) Thrombophlebitis and its complications like pulmonary embolism.

CHAPTER 3

HYSTERECTOMY IN OBSTETRICS

Hysterectomy for obstetric indications in young married women is sometimes necessary, and the frequency with which it is performed in an obstetric institution reflects the nature of obstetric practice in the surrounding district and also the obstetric judgment of the staff manning the institution. As a result of recent advances in the management of obstetrics, the indications for hysterectomy have been greatly reduced from what they used to be in the earlier part of this century.

Indications.

(1) *Vesicular Mole.* Vesicular mole in a multipara near or over forty years of age is, at times, an indication for performing a hysterectomy with the mole in situ (Plate 71). This is done with the object of avoiding the likely development of chorionic carcinoma. A perforating type of mole in a multipara should preferably be treated by hysterectomy.

(2) *Rupture of Uterus.* Formerly, rupture of the uterus in a neglected obstetric case was invariably treated by hysterectomy but the present trend is to conserve the uterus by suturing the tear. The advent of antibiotics has practically eliminated the risk of fulminating abdominal sepsis following rupture and thus enabled the obstetrician to conserve the uterus.

(3) *Concealed Accidental Haemorrhage.* Concealed accidental haemorrhage which failed to respond to conservative measures was formerly treated by caesarean section followed by hysterectomy when the uterus failed to contract and retract. At the present time, rupture of the membranes followed by pitocin drip usually succeeds in effecting a vaginal delivery and caesarean section is rarely required. If an abdominal delivery is decided upon it should be done before the grave complication of hypofibrinogenaemia develops.

(4) *Torsion of Gravid Uterus.* This very rare accident may necessitate hysterectomy after delivery of the child by caesarean section.

(5) *Perforation of Uterus.* Perforation of the uterus during criminal abortion may need hysterectomy. If the accident is not immediately recognised and the operation is continued, the uterus may be mutilated by perforation at several places. Hysterectomy may become imperative for severe bleeding from the lacerated area or from rupture of uterine blood vessels.

Steps of Operation

(1) *Clamping of Upper Parts of Broad Ligament.* Two long clamps are applied, about half an inch apart, to include the medial end of the Fallopian tube, the ovarian ligament, the ovarian blood vessels and, if possible, the round ligaments. The clamped part is cut between the two clamps. If the round ligaments are not included, they are similarly clamped and cut between the two clamps. The pedicles are transfixed and ligatured by chromic catgut or thread. The same procedure is carried out on the opposite side.

(2) The loose reflection of the peritoneum of the uterovesical pouch is cut from one side of the cut round ligament across the front of the uterus upto the round ligament of the opposite side.

(3) The bladder is pushed downwards from the front of the lower part of the body of the uterus and the cervix by a swab.

(4) The uterine blood vessels are clamped on either side with curved Kocher's forceps. The tip of the clamp should include about one-fourth of an inch of the lateral border of the uterus to ensure the clamping of all the blood vessels coursing along the lateral border. The blood vessels are cut near the uterus to prevent slipping of the vessels through the clamp. The pedicles are transfixed and ligated by chromic catgut or thread.

In lateral rupture of the uterus there is a diffuse haematoma of the broad ligament on the side of the rupture and it is not easy to clamp the uterine blood vessels in the usual way. The intact blood vessels are clamped and ligatured but no attempt should be made to search for lacerated veins in the broad ligament. Any bleeding vessels in the broad ligaments are ligatured but those already thrombosed do not need further attention. In ligaturing bleeding vessels in the broad ligament as small bites as possible should be clamped so that the ureter is not included in the ligature. In case

of doubt, the ureter should be traced downwards from the sacroiliac region.

(5) The ureters are likely to be damaged during clamping of the uterosacral ligaments and care should be taken to push the bladder well down on the anterior vaginal wall as also laterally.

(6) The cervix is then amputated. The base of the bladder may have been traumatised during rupture of the uterus. As a rule, a rubber catheter is kept in the bladder during the operation, and if the bladder has been ruptured the catheter can be seen protruding from the ruptured base.

(7) The amputated cervix or the vault of the vagina is sutured by No. 1 chromic catgut. The tear often extends along the vaginal wall. After the removal of the uterus, the torn portion should be traced down and the vagina sutured from below upwards by a continuous or interrupted catgut sutures.

(8) The cut anterior and posterior margins of the peritoneum of the broad ligament are sutured by a continuous stitch commencing from the pedicle of the tube and the ovary of one side across the pelvis to the opposite side.

CHAPTER 4

PUERPERAL STERILIZATION

Puerperal sterilization is a simple procedure. The operation is performed in some clinics as early as few hours after a vaginal delivery. It is preferably done on the second or the third day of puerperium because by then the woman has recovered from the stress of labour. Also, should there be some untoward symptoms, as pyrexia, excessive bleeding or sleeplessness, the operation can be postponed to a later date. The advantage of puerperal sterilization is that the woman can leave the hospital by the tenth day as is usual after a vaginal delivery.

Sterilization may be imperative for medical indications but in India socio-economic conditions is the prevailing indication. In an underdeveloped, overpopulated country, like India, it is a national problem. Though the governments of over-populated countries are seized with the problem, still this operation is legally not permissible except for medical indications. Prior written permission of the woman as well as of her husband must be taken. If the husband is out of station at the time of the operation, his written permission, attested by a magistrate or a Justice of the Peace, must be kept on record. Neglect to take these precautions may involve the obstetrician in legal proceedings at a later date.

In recent years, the number of sterilizations demanded for medical diseases has been considerably lessened, mainly due to co-ordinated efforts of the medical or surgical colleague and the obstetrician. Striking examples of such co-ordinated treatment are to be found in the management of the pregnant diabetic and pregnant cardiac cases.

Obstetric Indications. (1) At the third repeat caesarean section, (2) following repair of rupture of uterus in a multipara, (3) Rh or ABO blood incompatibility, (4) recurrent toxæmia of pregnancy, and (5) repeated puerperal psychosis.

Eugenics has figured prominently in recent years and sterilization should be favourably considered in all cases where the offsprings are likely to be a burden to the family and society.

After Effects of Puerperal Sterilization. It has been stated by some observers that, due to interference with the blood supply to

the ovaries, menstrual irregularities frequently occur after this procedure. This does not appear to bear out with clinical experience. In many cases, menstrual disturbances following sterilization are incidental and would have occurred apart from this operation. Sterilization is frequently performed in women in their thirties when the incidence of menstrual disturbance is high in women in general.

Untoward sexual and psychological reactions are met with in a small minority of cases. When both partners get the operation performed with each other's willing consent, sexual or psychological effects are most unlikely.

General Details for all Methods

Either a longitudinal midline incision extending from the fundus downwards or a transverse incision half an inch below the fundus is taken.

An incision, one inch in length, is sufficient for the Madlener and Pomeroy methods; but the incision should be about 2 inches in length when a cornual resection is decided upon.

The tube is brought out by picking it up in a Babcock forceps, about 2 inches away from its uterine attachment. Before commencing ligation, the entire tube is inspected, including the fimbrial extremity. By this way, any error of picking up the round ligament and ligating it instead of the tube will be eliminated.

Cornual Resection of Tube

Steps

(1) One and a half inches lateral to the uterine end of the tube, two artery forceps are applied, half an inch apart. The tube is cut between the two forceps.

(2) A clamp is applied to the mesosalpinx upto the lateral margin of the uterus. The mesosalpinx is cut.

(3) The tube is now held up and its interstitial portion is resected by snips of a curved scissors. During this procedure, one or two vessels will be cut and they should be separately ligated.

(4) The elliptical incision on the uterus is closed by a continuous stitch of fine thread. The mesosalpinx is ligated by a mattress suture.

(5) The cut outer end of the tube is tied by a fine thread. The end is stitched to the posterior surface of the uterus by two linen stitches.

*Madlener's Method**Steps*

- (1) A loop of tube about one and half inches long is crushed with a clamp at the site of ligation (Fig. 159).



Fig. 159. Madlener's method of ligaturing the tubes.

- (2) The tube is ligated with non-absorbable suture like silk or linen. The knuckle of the tube is not cut off.

*Pomeroy's Method**Steps*

The tube is held up by a Babcock's forceps in its medial, mobile portion and a catgut ligature is applied leaving a loop about one and a half inches long which is cut off half an inch above the ligature (Figs. 160, 161).

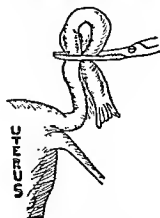


Fig. 160. Crushing of the loop of the tube by Pomeroy's method.

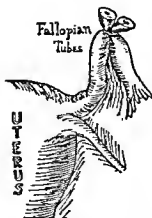


Fig. 161. Ligature applied and loop of tube cut off.

*Irving's Method**Steps*

(1) The tube is ligated in two places, about one inch from the uterine cornu, with No. 0 chromic catgut. It is then cut in between the two ligatures. The suture on the proximal end is kept long (Fig. 162).

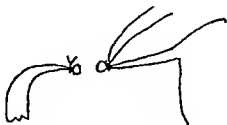


Fig. 162. Tube is ligated in two places and cut between two ligatures. The suture on the proximal end is kept long.

(2) The medial one inch severed stump is inobilized by dissecting it free from the mesosalpinx.

(3) A small $\frac{1}{4}$ inch incision is made on the posterior surface of the uterus near the cornu. ~~A 1½ cm. long bed is made by separating the superficial part of the musculature by a mosquito forceps.~~ A 1½ cm. long bed is made by separating the superficial part of the musculature by a mosquito forceps.

(4) One end of the suture on the medial end, kept long for this purpose, is threaded to a round bodied curved needle. The needle is passed into the tunnel and brought out at its distal end. The other end is similarly treated. The tube is now drawn into the tunnel and the sure is tied. The stump is thus buried (Fig. 163).



Fig. 163. Medial end is buried in the posterior wall of the uterus

(5) The ligatured distal end is buried between the two cut layers of the mesosalpinx. This step is not purposeful and is frequently omitted.

Shirodkar's Method ✓Steps

(1) The tube is cut across; each end is ligatured with linen half an inch from the cut end.

(2) This half inch length of tube of either side is folded backwards and ligatured again so that the two ends are turned away from each other (Figs. 164, 165).

CHAPTER 5

EVACUATION OF UTERUS IN EARLY MONTHS OF PREGNANCY

Evacuation of the uterus is necessary for the following conditions:

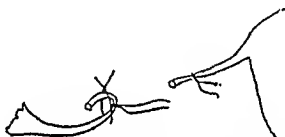


Fig. 164. The tube is cut across. The lateral cut end is folded backwards and is being ligatured again.

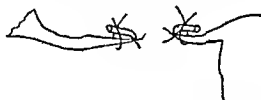


Fig. 165. Both ends are folded backwards and ligatured.

- (1) Inevitable abortion.
- (2) Incomplete abortion.
- (3) Missed abortion.
- (4) Vesicular mole.

Evacuation can be performed vaginally or by abdominal hysterotomy.

The methods employed for vaginal evacuation are: (1) detachment of the ovum by finger introduced into the uterine cavity, (2) detachment by means of a blunt curette, and (3) by vaginal hysterotomy.

Digital Evacuation

In many cases of inevitable abortion, the cervix is sufficiently open to allow one finger to be inserted into the uterine cavity. When the cervix is not sufficiently dilated, it is necessary to dilate it by Fenton's graduated dilators.

It is unwise to attempt digital separation through an incompletely dilated cervix. The evacuation is difficult and often incomplete, and is accompanied by profuse bleeding. Digital evacuation should be carried out quickly and deftly (Fig 166). Until the en-

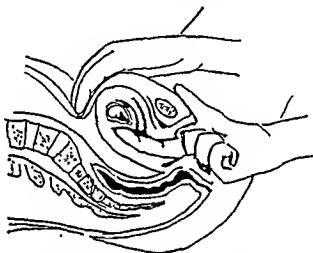


Fig. 166. Digital separation of the ovum.

tire products are evacuated, bleeding continues, but once all the products are evacuated, the uterus contracts firmly and the bleeding becomes negligible. After digital separation, the loose portions are removed either digitally or by means of an ovum forceps (Fig. 167). Ovum forceps should never be used to detach the ovum but



Fig. 167. Ovum forceps.

only to remove the chorionic tissue lying free in the uterine cavity. An ovum forceps may easily perforate the soft uterus and cases

of pulling down the omentum or the loops of intestines are sometimes witnessed. Therefore, an ovum forceps needs to be used very carefully. When bleeding continues after complete evacuation, it is traumatic in origin. Lateral tears of the cervical canal is the most common form of trauma and the bleeding is readily controlled by firm packing of the uterine cavity and the cervical canal.

Formerly, when the cervix was closed or very little dilated, laminaria tents were employed to dilate the cervix (Fig. 168). Their use is limited in present-day obstetrics. Laminaria tents are made of seaweed and have the property of swelling in presence



Fig. 168. Laminaria tents.

of moisture. Laminaria tents are sterilized by keeping them immersed in a bottle of absolute alcohol for at least seven days. Dry sterilized tent in sealed glass tube ready for use is also available.

In a multipara, the cervix is patulous and a tent can be easily inserted. The upper end of the tent must go above the internal os for about 1 cm. The cervical canal is packed by two or three tents. The tents are kept in place for 24 hours. The tents are pulled out by the string attached to its lower end and after making sure that the cervical canal and internal os are sufficiently dilated, anaesthesia is given and digital evacuation commenced. Not infrequently, the internal os has not sufficiently dilated as a result of faulty insertion of tents and then fresh tents are inserted to effect further dilatation. When the tents project into the uterine cavity for more than an inch, the portion beyond the internal os swells so much that it becomes impossible to pull the tents out. It is then necessary to keep them in place for another 24 hours so that there is further dilatation of the internal os and the cervical canal to allow their removal. The difference between dilatation by Fenton's metal dilators and by laminaria tents is that, with metal dilators, the external os is widely dilated but the internal os is not as much widened as the external os. The dilatation is in the form

of a cone. In contrast, the dilatation by the laminaria tents is cylindrical, that is the external os, the cervical canal and the internal os are equally widened. The dilatation is in the form of a cylinder (Fig. 169). It is obvious that the ease with which the finger can be passed following dilatation by the laminaria tents is not available when dilatation is effected by metal dilators.

When the uterus is enlarged to 12 weeks' size or more, the finger, to start with, can extend only into the lowermost part of the uterine cavity. Evacuation is commenced at this part and small bits of the products are expelled. The size of the uterus gets slightly reduced and it now becomes possible to reach the products at a higher level. In this manner, the finger reaches higher and higher

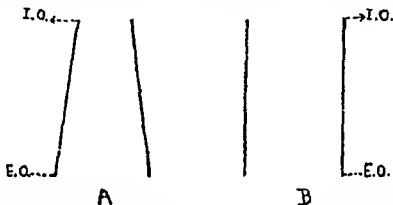


Fig. 169. Diagram showing the mode of dilatation of the cervical canal by (A) metal dilators, and (B) laminaria tents. E.O., external os, I.O., internal os.

as more and more portions are separated and evacuated. Finally, the size of the uterus is considerably reduced and the finger can, with ease, reach the fundus from where the final portion is evacuated.

In vesicular mole, the size of the uterus is enlarged upto or even above the umbilicus, and it takes several minutes to completely evacuate the contents.

During evacuation, the uterus should always be controlled by the other hand placed on the abdomen. The abdominal hand pushes the uterus downwards and, as some of the portions get separated, the uterus is squeezed by the external hand to evacuate the separated portions.

Bleeding is, as a rule, brisk and continuous during evacuation. A drip containing 5-10 units of oxytocin should always be started

a few minutes before commencing evacuation so that the soft uterus remains firmly contracted and thus reduces the blood loss. The firmly contracted uterus diminishes the risk of perforation of the uterus.

Evacuation By Means of A Curette

Evacuation of the products of conception by the curettage is not without danger. The enlarged soft uterus may easily be perforated. The larger the uterus the greater is the danger of this accident and curettage of a uterus bigger than 10 weeks' size should never be attempted. Should the operator suspect that the uterus has been perforated, he should stop the operation and not persist in his attempt to evacuate the uterus. An injection of 0.5 mg. ergometrine is given and a drip containing 5 units of an oxytocin is started intravenously. Unless a big blood vessel is perforated, serious intra-abdominal or vaginal haemorrhage is unlikely to occur.

When curettage is continued after perforating the uterus, omentum or a loop or loops of intestine are likely to be drawn out into the vagina through the perforation (Fig. 170).

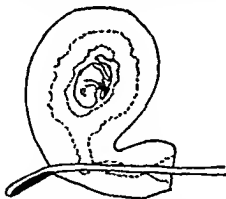


Fig. 170. Perforation of the uterus by curette.

Only a blunt curette should be employed (Fig. 171). A sharp



Fig. 171. Blunt curette

curette should never be used as it may easily damage the soft uterine wall. Cases of injury to one or more uterine veins coursing

along the lateral wall of the uterus are met with resulting in a broad ligament haematoma or profuse uncontrollable vaginal bleeding.

Gentle curettage, after digital evacuation of a vesicular mole or products of an abortion, is advisable to remove the thick decidua and small pieces of chorionic tissue still attached to the uterus. At this stage, curettage is safe because the uterus after complete evacuation contracts firmly and becomes very much smaller in size. The dangers of perforating the uterus or of haemorrhage are now remote.

Hysterotomy

By hysterotomy is meant the evacuation of the products of conception by incision on the body of the uterus or the cervix.

Abdominal Hysterotomy. In abdominal hysterotomy, the anterior surface of the body is incised vertically as in a classical caesarean section. To reduce the risk of rupture of the scar in a subsequent conception, some obstetricians prefer to cut the utero vesical peritoneum and put a transverse incision into the lower part of the body as in lower segment caesarean section. The main advantages of an abdominal hysterotomy are that bleeding is much less than during digital evacuation and, as the evacuation is under direct vision, there is no chance of incomplete removal. It is, therefore, a method of choice for evacuation of a uterus enlarged to more than 14 weeks. The uterine incision is sutured in layers as in caesarean section.

Vaginal Hysterotomy. Vaginal hysterotomy is not favoured by many obstetricians in this country. In countries where abortion is legalised, even pregnancy of 24 weeks' size is terminated by vaginal hysterotomy. Bleeding is much more than during an abdominal hysterotomy. Incompetency of the cervix during subsequent pregnancy may occur as a result of the scar on the cervix.

A transverse incision is made on the anterior wall of the cervix about an inch above the anterior lip. The bladder is pushed up by gauze pressure aided by scissors. The anterior wall of the cervix is cut upto some distance beyond the internal os. After evacuating the products of conception, the cervical incision is sutured in two layers. Finally, the transverse incision on the vagina is sutured.

CHAPTER 6

INDUCTION OF LABOUR

Indications. Post-maturity. When pregnancy continues for longer than 42 weeks, 294 days, it is generally regarded as post-mature, and one which extends upto 43 weeks, 300 days, is definitely post-mature. The chief disadvantage of post-maturity is intra-uterine death from progressive anoxia of the foetus.

Hydromnios. When hydramnios is associated with gross foetal abnormality, termination by rupture of the membranes is indicated. Respiratory or circulatory distress from overdistension of the uterus with a normally developed foetus can be relieved by abdominal paracentesis and hardly ever termination is required.

Pre-eclamptic Toxaemia. Premature induction of labour for severe degree of pre-eclamptic toxaemia was formerly an accepted indication, but, with the use of hypotensive drugs, induction of labour is seldom necessary. In fulminating toxaemia, an immediate termination by caesarean section is preferable to slow onset of labour by induction. Some consider intercurrent eclampsia as a positive indication for terminating pregnancy.

Cephalopelvic Disproportion. Some years ago, premature induction of labour for cephalopelvic disproportion was in favour with some obstetricians. Each week, after the 32nd week, cephalopelvic disproportion was estimated and, no sooner overlapping of the head over the symphysis pubis was detected, labour was induced.

The chief disadvantage was that when overlapping occurred before the 36th week the infant was too premature to survive birth. When overlapping occurs after the 38th week, a trial of labour is preferable to an induction because failure or success of a trial is an useful guide for future pregnancies.

Diabetes Mellitus. Severe pre-eclamptic toxaemia or severe hydramnios frequently complicates pregnancy in a diabetic patient and termination of pregnancy is advisable at the 36th week. Apart from the complications there is a risk of intra-uterine death in a diabetic pregnancy during the last four weeks.

Habitual Death of Foetus in Later Weeks of Pregnancy. In those cases where intra-uterine death of the foetus has occurred

in the last few weeks of previous pregnancies without an obvious cause, timely termination of pregnancy is indicated to forestall foetal death.

Intra-uterine Foetal Death. Termination of pregnancy is indicated after foetal death.

Methods of Induction of Labour

- (1) Rupture of the membranes.
- (2) Oxytocic drip.
- (3) Medical induction.
- (4) Intra-uterine gum elastic bougies (now obsolete).
- (5) Hydrostatic bag (now obsolete).
- (6) Intra-amniotic injection of hypertonic solution or normal saline (only when the foetus is dead).

(1) *Rupture of Membranes.* It is the oldest method known to the obstetricians for inducing labour. Formerly, rupture of the fore-waters was carried out but this had several disadvantages, such as loss of bag of waters, danger of cord prolapse and chances of sepsis. These disadvantages were overcome with the introduction of "S" shaped catheter designed by Drew Smythe in 1931 for rupturing the hind waters (Fig. 172). Since then, whenever labour is to be induced, it is done by rupturing the hind waters.



Fig. 172. Drew Smythe membrane perforator.

Labour usually commences within 12 to 24 hours after the rupture of the membranes, but it may take longer or, sometimes, may not set in at all.

Steps of Operation. (1) Sim's speculum is inserted into the vagina which is then swabbed by Dettol or aqueous solution of acriflavin or any other antiseptic solution. When the cervix is patulous and admits one finger the membranes are separated by the finger all round for a distance of about one inch.

(2) A Drew Smythe's catheter with the stilette slightly withdrawn is guided by the finger into the cervical canal until the tip touches the head. In order to glide the tip along the posterior uterine wall beyond the head, the lower external end of the catheter is raised towards the symphysis pubis and then gently lowered towards the perineum so that the cephalic curve of the catheter passes closely against the curvature of the head and comes to lie between the membranes and the uterine wall.

(3) The catheter is then pressed against the perineum so that the upper end comes in contact with the membranes. The stilette is pressed home and the membranes are punctured. The stilette is then withdrawn and the liquor amnii escapes. If it does not, then slight jerk is given and the liquor then commences to flow. The quantity of liquor is measured and about 10-15 ounces should be withdrawn. In a case of hydramnios, the quantity of liquor drained would be several pints.

The difficulties experienced during rupture of the hind-water are: (1) accidental rupture of the fore-waters and, (2) bleeding from the placental site when the placenta is situated rather low down in the posterior uterine wall. In the latter event, the catheter should be partially withdrawn and passed in some other direction. If the second attempt also causes bleeding from the placental site, then it is preferable to rupture the fore-waters.

This method is frequently combined with medical induction. Should labour not start spontaneously within 24 hours, a drip containing 5 units of pitocin is set up with a flow of 20-30 drops per minute.

(2) Oxytocic Drip. Theobald, was the first to advocate induction of labour by oxytocic drip. When labour is induced some weeks before term, the cervix is usually unripe and labour will not start until the cervix is ripened first. A pint of 5% glucose drip containing 5 units of oxytocin is commenced at the rate of 30 drops per minute. Cervix usually fails to ripen with the first bottle and it may be necessary to give three or more such drips before labour commences.

At term and particularly in cases of post-maturity, labour starts within an hour of the commencement of the drip.

Once labour pains commence, a drip containing $2\frac{1}{2}$ units of oxytocin to a pint of 5% dextrose solution is substituted and the flow of the drip adjusted according to the frequency and duration

of contractions. Oxytocic drip may be combined with medical induction or artificial rupture of the membrane.

(3) Medical Induction. It is one of the oldest method, but it has undergone considerable modifications in recent years. Formerly, quinine 10 grs., three times at two hourly interval, was part of medical induction but in practice it just produced uterine irritability without bringing effective contractions. Besides, intra-uterine death sometimes occurred as a result of giving quinine in large doses. To minimise the dangers of intra-uterine death, the dose of quinine was gradually reduced and at present quinine is not used at all for medical induction.

The present routine is to give castor oil, 1½ ounces, early in the morning. A hot shower bath either precedes or follows the dose of castor oil. Soon after castor oil has acted, a warm enema is given. If labour does not start within two hours, an oxytocin drip is set up as described previously. Formerly, 2 units of pitocin was injected intramuscularly every half hour and 6-8 such doses were given.

Sometime back large doses of oestrogen were administered prior to medical induction of labour in the hope of sensitizing the uterus, but at the present time this practice is discontinued by most obstetricians.

(4) Krause's Gum-elastic Bougies. Krause advocated this method in 1855. In this, now obsolete method, two or more bougies were passed between the membranes and the uterine wall. Infection was its greatest disadvantage and, sometimes, when bougies passed near the placental attachment bleeding occurred. Instead of the bougies, a stomach tube was used by some.

(5) Hydrostatic Bag. Unless the cervix is two fingers dilated, induction by insertion of a bag is not possible. It had the disadvantage of displacing the presenting part upwards. It is now an obsolete method.

(6) Intra-amniotic Injection of Hypertonic Glucose Solution or Normal Saline. This method is rarely employed and that too only when the foetus is dead. 150 c.c. of liquor is withdrawn by abdominal paracentesis and replaced by hypertonic glucose or normal saline.

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CHAPTER 7

VERSION

Version is an operation by which the presentation of the foetus is manually altered. In a longitudinal lie of the foetus one pole is substituted for the other by turning the foetus through 180° . By version, a transverse or an oblique lie is converted into a longitudinal lie.

According as the head or the breech is made into the presenting part, the operation is termed *cephalic* or *podalic* version respectively. There are three methods of performing version. *External version* when the turning is accomplished externally by manipulations through the abdominal wall. *Internal version* is performed during labour by introducing the whole hand into the uterine cavity through the dilated cervix. Braxton Hick's bipolar version is also performed during labour by introducing two fingers into the uterine cavity through a cervix dilated to two or more fingers. In both, internal and Braxton Hick's methods, simultaneous external manipulations are carried out through the abdominal wall by the other hand.

External Version

External version is the most commonly used method of correcting an abnormal lie during pregnancy or during labour.

Indications. During Pregnancy.

Breech Presentation. This is the commonest indication for cephalic version. It is chiefly performed for reducing perinatal mortality arising from difficulties in the delivery of the after-coming head. An estimation of cephalopelvic disproportion can also be made after performing a cephalic version.

Transverse or Oblique Lie. More often the lie is oblique than absolutely transverse. In an oblique lie the head or the breech is in one of the iliac fossae and the other pole near the costal arch of the opposite side. In primigravidae, with good previous obstetric history, cephalic or podalic version is performed depending on whether the head or the breech is in the iliac fossa.

. At what time during pregnancy should an external cephalic version be performed is a subject constantly under discussion. In multigravidae with a good previous obstetric history, version for a breech presentation should be done at the 34th week since spontaneous rectification is very likely to occur by then and, even when it does not, version at 34 or 36 weeks can be usually successfully performed. On the other hand, in primigravidae, version should be done at the 30th week. Since breech with extended legs is common in primigravidae, version has a better chance to be successful when performed at the 30th week. Again, breech with extended legs in primigravidae has much less chance of spontaneous rectification than in multigravidae and to wait until the 34th week is to expect frequent failures to turn the foetus.

Steps of Operation

Version should preferably be performed without anaesthesia. In a primigravida, it is sometimes necessary to give anaesthesia. Only an experienced obstetrician should undertake external version under anaesthesia as by his experience he will avoid complications resulting from undue pressure. The patient should be completely relaxed by deep anaesthesia. Eastman states that there is 1.7 per cent perinatal mortality attending version under anaesthesia.

Version is best performed in the morning on an empty stomach and after giving an enema. A proper abdominal examination should be performed to note the position of the head and the back, and to note whether the breech is above the pelvic brim or has descended into the pelvic cavity. The type of breech and the position of the head and back are preferably ascertained by taking an antero-posterior radiograph.

Following conditions help towards successful version: (1) Presenting part must not be deeply engaged. (2) There must be sufficient quantity of liquor amnii to allow easy manipulations. (3) The abdominal wall should not be very tense. (4) Uterus should not be irritable otherwise it goes into contraction no sooner version is attempted.

External version cannot be satisfactorily performed single handed, particularly in primigravidae, so it is better to have two persons standing on the opposite sides of the patient, one to manipulate the head and the other the breech. If the breech has des-

cended into the pelvic cavity, a third assistant will be required to push the head up above the pelvic rim by his two fingers in the vagina.

In external cephalic version for breech presentation, the head is preferably turned in the direction opposite to the side of the back so as to keep the head flexed. In breech with extended legs, the feet lying close to the face and the neck and acting like a splint, often prevent complete flexion of the head and version is difficult to perform in this way. In such cases, the head is sometimes turned on the same side as the back. Extension of the head seldom persists after version and therefore this alternative method is not disadvantageous.

Steps

(1) The breech is pushed into the iliac fossa on the same side as the back and at the same time the head is pushed across the middle line towards the costal margin. Steady pressure is kept by the 'heel' of the hand. The head has a tendency to slip back and, to prevent this occurring, the other hand is kept as shown in (Fig. 173).



Fig. 173. External cephalic version in breech presentation. The head is moved in the direction of the back and the breech in the opposite direction.

(2) Continuous pressure is maintained and by sudden thrusts, every few seconds, the breech and the head are pushed further and further. Most discomfort is caused when the foetus comes to lie in the transverse axis (Fig. 174).

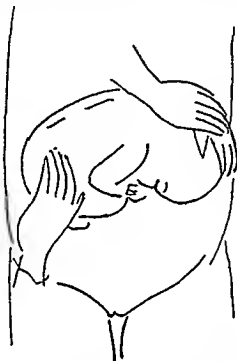


Fig. 174. Foetus is now turned into a transverse axis.

Once the head descends below the transverse axis towards the iliac fossa, the breech is manipulated to the fundus. The head can now be easily brought in the centre of the lower pole of the uterus (Fig. 175).

Internal Podalic Version

Till the beginning of the twentieth century, internal podalic version was the sheet anchor of the obstetricians for every form of dystocia. The changing trends in obstetric management during the last thirty years have resulted in the fall of incidence of internal podalic version. The fall in incidence is particularly noticeable in obstetric institutions where, as a result of antenatal supervision, obstetric abnormalities are diagnosed during pregnancy. However, in domiciliary practice, with scant or no antenatal supervi-



Fig. 175. Version completed.

sion, obstetric emergencies commonly arise which are best treated by internal podalic version.

Incidence. At the N.W.M. Hospital the incidence was 0.52 per cent in the 7-year period, 1933-1939, which has fallen to 0.32 per cent in the period 1954-59. At the Madras Medical College, Krishna Menon found the incidence to be 0.6 per cent during 1953-57. Keetal et al mention it to be 1.0 per cent between 1941-1950.

In the majority of cases, internal podalic version is performed in multiparae. It is safe and easy to perform in parity between II and V but is a dangerous procedure in parity VI and above. In primiparae, it is seldom resorted to because of the probable difficulty of delivering the after-coming head.

Indications. In *Second of Twins*. It is relatively a simple and safe procedure because the baby is usually small, the passages are roomy, and there is sufficient liquor. It is indicated when the lie of the second foetus is transverse but, in most cases, the transverse lie can be readily corrected by an external version performed immediately after the delivery of the first foetus. Should the cord prolapse with the rupture of the second bag, an internal podalic version and breech extraction is immediately necessary. Compound

presentation in the second of the twins needs internal podalic version when the limb cannot be easily pushed up out of the way.

"Failed" Forceps. In the past when high forceps delivery was practised, forceps extraction, at times, failed either because of the high, almost floating, position of the head or because of an unrotated head. It was then the practice to do an internal podalic version and deliver the child. In rural areas, it is still frequently resorted to for these reasons, but in hospital practice high forceps delivery is never resorted to as such cases are nowadays delivered by caesarean section.

Prematurity. In a series of 200 cases of internal podalic version at the N.W.M. Hospital, about one-third were premature. Abnormal lie is common before the 34th week of gestation and, therefore, internal podalic version for premature labour has and will always remain a common indication. In most premature cases, the lie is transverse and there is associated cord prolapse. Because of prematurity, caesarean section is not considered.

Prolapse of Cord. When prolapse of the cord occurs towards the end of the first stage, delivery by the immediate application of forceps is the best form of treatment, but internal podalic version in multiparae with a previous good obstetric history is a useful alternative procedure.

Placenta Praevia. A quarter of a century ago internal podalic version was a very common mode of terminating cases of placenta praevia. Nowadays, internal podalic version for placenta praevia is seldom practised except when the foetus is very premature. In domiciliary practice, internal podalic version for incomplete placenta praevia is, at times, a life-saving procedure.

Malpresentations. At one time, internal podalic version was frequently employed in cases of persistent brow, face or occipito-posterior positions. In multiparae (parity 2-5), it is an easy and safe procedure when the head is floating and the membranes have recently ruptured. In hospital practice, however, manual rotation and forceps or caesarean section is usually performed and, only in an occasional case, internal podalic version is resorted to.

Conditions For Internal Podalic Version

(1) Dilatation of Cervix. With a fully dilated cervix, it is technically an easy operation and an immediate delivery can be readily effected. The prospects of live birth are good.

At the N.W.M. Hospital, 72 per cent living babies were born when internal podalic version was performed with a fully dilated cervix. When the cervix was three-fourths dilated, only 27 per cent babies were born alive; and, when the cervix was half dilated, not a single foetus was born alive. Moreover, premature babies were mostly extracted soon after version, whereas in full term babies, the leg was pulled out and traction was exerted till complete dilatation of the cervix.

(2) *Relationship between Rupture of Membranes and Performance of Internal Podalic Version.* When internal podalic version is performed soon after the membranes have ruptured, the presence of a good quantity of liquor makes version an easy and safe procedure. On the other hand, when the membranes have ruptured for some time, the liquor has drained away and then the operation becomes technically difficult.

(3) *Uterine Action.* When the uterus is normally contracting and relaxing, the operation is safe and easy to perform. In cases of tonically contracted uterus, the foetus is firmly gripped by the uterus and it is then dangerous to do intrauterine manipulations for fear of rupturing the greatly distended lower uterine segment. It is therefore very important to ascertain the nature of uterine action and the degree of distension of the lower uterine segment before version is undertaken.

Maternal Complications

(1) *Cervical Tear.* When version is performed with the cervix partially dilated, cervical tear is likely to occur which may extend to the broad ligament and then precipitate an emergency.

(2) *Rupture of Uterus.* This frequently occurs when internal version is attempted in a case of prolonged labour with a tonically contracted uterus. It should be borne in mind that, even when version is performed under favourable conditions, rupture can still occur and therefore exploration of the uterus should be routinely carried out after delivery has been completed.

(3) *Postpartum Haemorrhage.* This may occur before the expulsion of the placenta or after it. Many obstetricians prefer to do manual removal of placenta immediately after the delivery of the child and to explore the uterus whilst the patient is still under anaesthesia.

Steps of Operation

For successful version, complete relaxation under general anaesthesia is necessary, more so when it is performed in cases of prolonged labour. The only exception is version on the second of twins when it can be performed without any anaesthesia. Spinal anaesthesia is obviously contraindicated.

The dorsal position is the most suitable as abdominal manipulations can be freely performed. As far as possible the lie of the foetus should be made out by abdominal palpation but, when the uterus is tonically contracted, the lie can be properly ascertained only after introducing the hand into the uterine cavity.

There is a considerable difference of opinion regarding which hand should be introduced into the uterus. Clinical experience, however, shows that the hand which naturally adopts itself to the position in which the feet lie should be selected.

Divergent views are held regarding the foot that should be brought down, but for practical purposes the foot which is most easily reached is the one that should be brought down. In transverse lie, the upper foot, that is the foot belonging to the opposite side to the presenting shoulder, is preferably chosen when the back is posterior and the lower foot when the back is anterior, but, if the selection of the appropriate foot requires prolonged and complicated manoeuvres, it is far better to get the lower foot. The reason for pulling down the appropriate foot is that rotation of the foetus with its back to the front is easily accomplished. For cephalic presentations there is no preference and the foot that can be easily reached is the one that should be selected.

(1) The gloved hand, shaped like a cone, is introduced into the uterine cavity. Mobility of the foetus is ascertained by displacing the presenting part to one side; this is a good guide as to whether version will be easy or difficult and dangerous. The other hand is placed on the abdomen above the fundus. It acts as a control to the internal hand (Fig. 176).

(2) In cephalic presentation, the best guide to reach the foot is to pass the hand upwards along the back and then along the buttocks to the foot. It is sometimes difficult to distinguish between a hand and a foot in a transverse lie, but the heel is the best guide and from thence, to avoid mistake, the limb is followed up to the buttocks. Three anatomical differences help in distinguishing foot from hand: (1) the toes of foot are in a line, while the thumb is

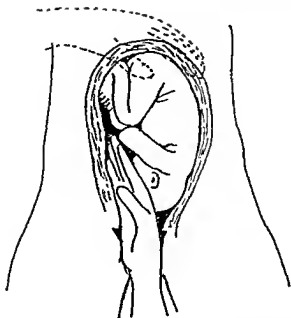


Fig. 176. Internal podalic version. The hand is in the uterine cavity.

at a distance from the fingers, (2) the foot is more or less fixed to leg at a right angle while the hand has considerable mobility, and (3) the rounded shape of the heel is characteristic.

(3) Having grasped the foot, traction is made on it and, at the same time, the head is pushed up by external pressure applied over the abdominal wall (Fig. 177).

Traction on the foot at this stage should be very gentle. Effort is made to push the head up by external pressure. When the head has been pushed up beyond the transverse axis of the foetus, further traction is made on the foot (Fig. 178). The foot can now be easily brought out through the cervix and in a successful version the knee can be drawn up to or beyond the vulva (Fig. 179).

A foot drawn down just through the cervix only indicates that the foetus is doubled up and is lying in the transverse axis of the uterus. It should not be allowed to remain in this dangerous position of overstretched lower uterine segment.

(4) In a transverse lie, the arm is commonly prolapsed and is seen at the vulva. Before commencing internal version, a loop of gauze is applied to the wrist to prevent the arm getting extended alongside the head (Fig. 180).

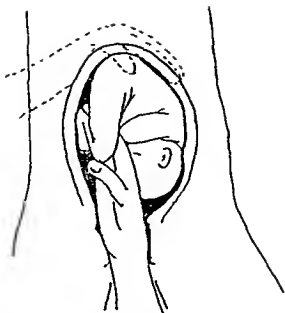


Fig. 177. Internal podalic version. A foot is grasped.

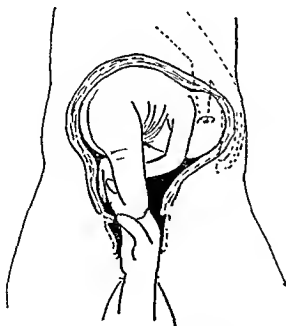


Fig. 178. The foot is brought to a lower level. The external hand pushes the head towards the fundus.

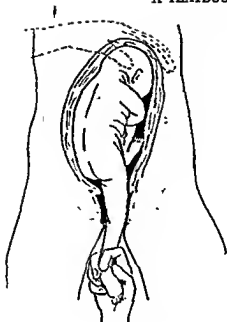


Fig. 179. Internal podalic version. The leg is brought down.

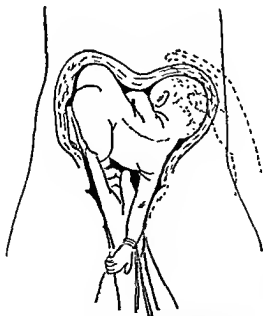


Fig. 180. Internal podalic version in shoulder presentation. Tape is applied to the prolapsed arm. The leg is grasped.

If the head cannot be pushed up by abdominal pressure, a loop of sterilized gauze is fixed round the ankle and pressure on the foot is maintained through it. This leaves room in the vagina for the hand to be introduced into the uterine cavity, and the head is pushed up by combined external and internal pressure (Figs. 181, 182).

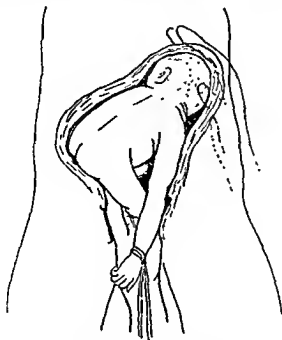


Fig. 181. The leg is being pulled down. The external hand pushes the head towards the fundus.

During uterine contraction, all intrauterine manipulations are stopped and the hand is allowed to remain passively over the foetus until the contraction is over.

After version, the decision as to whether immediate breech extraction should be done or labour allowed to continue will depend on circumstances.

Braxton Hick's Bipolar Version

Bipolar version is rarely performed nowadays but, to perpetuate the memory of the great obstetrician of his time, the author has included a description of it. It was then performed for a number of indications because in those days vaginal delivery was the only safe mode of delivery.

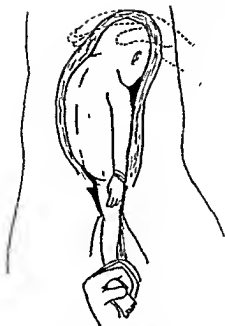


Fig. 182. Leg brought down.

Bipolar version is a podalic version and can be performed from the time when the os admits two fingers and until the presenting part is firmly engaged in the pelvic brim. It is much more likely to be successful when it is undertaken before the rupture of the membranes than when some time has elapsed after the membranes have ruptured.

It is performed under anaesthesia with the patient in the lithotomy position. After preliminary aseptic precautions, a gloved hand is passed into the vagina. In a primipara there is difficulty in introducing the whole hand and the hand is introduced with the thumb remaining outside.

Two fingers are passed far up into the cervix and the membranes are ruptured. The presenting part, the head, is pressed upwards and to one side. The head is pushed sideways towards the back (Fig. 183). Fundal pressure is applied in the direction opposite to the back. In this manner, the foetal abdomen is brought over the internal os and the flexed knees will come in contact with the fingers in the cervix.

The foot is held between the two fingers and, by firm fundal pressure, brought out through the cervix (Fig. 184). The head is

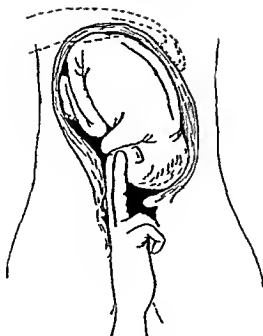


Fig. 183. Bipolar podalic version. The head is pushed into the iliac fossa.

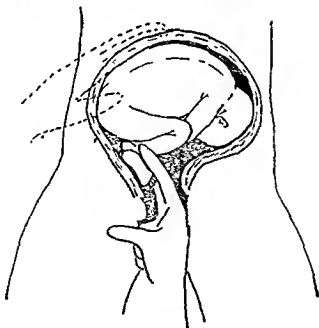


Fig. 184. Bipolar podalic version. The foot is grasped.

pushed upwards by external manipulations and, as the head goes upwards, the foot can be brought further and further down and,

finally, when version has been successful, the knee appears at the vulva (Fig. 185).

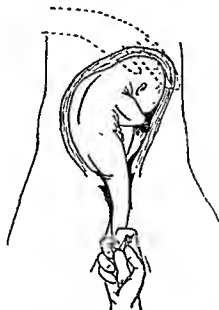


Fig. 185. Bipolar podalic version. The foot is pulled down.

If the foot cannot be gripped by the fingers, a sponge holding forceps is passed into the cervix by the side of the fingers and the ankle is caught into the grip of the forceps and brought down.

CHAPTER 8

FORCEPS

Since ancient days instruments like pins, hooks, knives, etc. were being used for the delivery of the foetus in cases of obstructed labour but their use resulted in the birth of a dead and often mutilated child. The obstetric forceps was the first instrument available to aid the extraction of a living foetus and it revolutionized the practice of midwifery.

Jean Palfyn in 1720 gave the first public demonstration and description of the obstetric forceps. His instrument consisted of two spoon shaped blades with wooden handles. After applying the blades to the sides of the foetal head the handles were to be tied together with a handkerchief before exerting traction. By 1734 Dussé had improved this instrument by crossing the blades, lengthening the handles and adding a screw for locking the blades.

However, a family of doctors practising in London, Chamberlen by name, was already using forceps for well over 100 years prior to Palfyn's description. Peter Chamberlen (senior) had invented forceps by 1600 or possibly even earlier, but it was kept a strict family secret for three generations. In 1693 Hugh Chamberlen sold the secret of the forceps to Roger Roonhuysen, a practising obstetrician in Amsterdam. Roonhuysen and his associates maintained the forceps as a monopoly and made a fortune by virtue of a municipal law enforcing every practising obstetrician in Amsterdam to purchase the secret from Roonhuysen. Rathlaw refused to purchase the secret and was denied permission to practice. He, however, obtained drawings of the forceps from a student who lived with Roonhuysen and published the nature of forceps in 1732.

Chamberlen's forceps was superior to that of Palfyn's and consisted of two members made of metal each having spoon-shaped but fenestrated blade, lock or pin-joint, and handle curved like scissors-handles.

These original forceps were adequate enough only for the extraction of the head lying low down in the pelvis. They were soon modified to improve their mechanical efficiency to enable extraction of the head lying high up in the pelvis.

The first important addition to the forceps was that of a pelvic curve by Andre Levret in 1746. From the very beginning the blades had a curve for adaptation to the round head of the foetus, the cephalic curve. But viewed in profile the instrument was straight from end to end. The pelvic canal, however, is curved. Hence, when the straight forceps was applied to the head situated high up in the pelvis, the blades grasped the part of the head lying behind the centre of the pelvis. Thus in occipitoanterior position the blades would grasp the sincipital end and traction would tend to cause extension of the head. To overcome this, Levret curved the blades forwards, this second curve on the forceps blade is known as its pelvic curve. This enabled a central grip of the head even when the head was in upper part of the pelvis.

In 1744 William Smellie invented the English lock consisting of a groove or slot at a fixed point for each member. He also added shanks to the forceps by lengthening the distance between the toe of the blade and the tip of the handle to enable the locking of the forceps outside the vulva even when applied to the head at the brim.

The traction exerted by the forceps should be along the axis of the pelvis. It should be at right angles to the plane of the pelvis occupied by the foetal head at all times during its descent through the pelvic canal. When a straight forceps is applied to a head at the brim the traction force is directed far forwards and a substantial part of the force is wasted against the symphysis pubis. This misdirection of force is not much corrected by the addition of pelvic curve to the instrument. Pajot's manoeuvre was devised to overcome this wastage of traction force. In this manoeuvre the right hand grasps the handles of the forceps and exerts downward and forward traction while the left hand grasps the shanks and simultaneously exerts a backward traction on it.

In 1877, Tarnier introduced the principle of axis traction to achieve traction in the direction of the pelvic axis irrespective of the level of the head. He employed specially devised axis traction rods and handle for the purpose. Milne Murray's forceps is the best example of this type of forceps (Fig. 186). The axis traction rods are attached to a slot at the base of the fenestrum of the blades. The rods are so curved as to lie in contact with the lower end of the blades and the shanks but divert away from the handles and are joined by an axis traction bar. The handles of the forceps are not used for traction but are provided with a screw, the fixa-

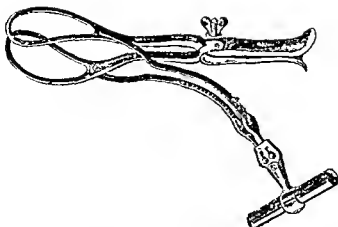


Fig. 186. Milne Murray's axis traction forceps.

tion screw, to keep them together during traction. Traction is exerted at the axis traction bar taking care to see that the axis traction rods are maintained parallel to the shanks all the time. The direction of the force used is represented by a line joining the traction bar to the centre of the fenestrum and coincides with the axis of the pelvic cavity at all the successive levels occupied by the head during its descent.

In Neville's axis traction forceps the axis traction bar is attached to the handles just behind the lock (Fig. 187). A pointer on

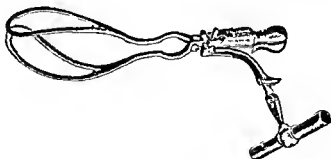


Fig. 187. Neville's axis traction forceps.

the traction bar handle indicates the direction of pull.

Bill has devised a traction bar which can be attached to the handle flange of many different types of forceps.

Classification of Forceps Operations

Forceps operations have been traditionally classified into high, mid and low, depending on the level of the foetal head.

Forceps operation is designated as high when the biparietal diameter is in the pelvic brim or above it. Forceps-application to a head with the biparietal diameter above the pelvic brim is often described as 'forceps on the floating head'. High forceps operation is not only difficult but is dangerous to the foetus and the mother and hence has no place in modern obstetrics.

Forceps operation, when the biparietal diameter has passed the pelvic brim but is yet above or at the level of the ischial spines, is termed as midforceps. If the biparietal diameter is at the level of ischial spines and the internal rotation is complete, midforceps operation is usually not difficult. But if the biparietal diameter is above the level of the spines and the head is unrotated the operation is complicated and difficult.

Forceps operation on a head after the biparietal diameter has passed the level of the ischial spines is called low forceps. It is easy and is the commonest of all forceps operation.

Recently, Dennen has classified forceps operations into high, mid, low-mid and low. His classification is an improvement over the traditional classification and is more useful in actual practice. In high forceps operations the biparietal diameter is in the brim and the lowermost bony point of the head is just above the plane of the ischial spines. In mid forceps operations the biparietal diameter is below the pelvic brim, the lowermost bony point of the head is at or just below the plane of the ischial spines and the head nearly fills the hollow of the sacrum. In low-mid forceps operations the biparietal diameter is at or just below the plane of the ischial spines, the lowest bony point of the head is within a finger's breadth of the perineum between contractions and the hollow of the sacrum is completely filled by the head. In low forceps operations the biparietal diameter is in the quadrilateral plane of the outlet and the lowest bony point though visible during the contractions is on the perineum between contractions.

Functions of Forceps

The main function of the forceps is traction. The capacity of the forceps to exert traction, particularly when fitted with an axis traction device, is tremendous. Forceps, however, must never be used to drag the head out of the pelvis by brute force but should be availed of merely to aid or substitute normal uterine action.

Forceps is often used as a rotator of the foetal head. Forceps

vary in their efficiency as a rotator. In fact, there are forceps, like Leff's forceps meant for exclusive use as a rotator. Kielland's forceps and Barton's forceps (Fig. 188) are specially designed to

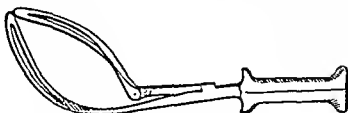


Fig. 188. Barton's forceps.

serve as efficient rotators in addition to acting as tractors. Even the usual long curved forceps can be employed as a rotator. In posterior or transverse positions of the head or the face the forceps can be used to rotate the occiput or the chin anteriorly. Present tendency is to employ forceps rotation in preference to manual rotation.

Flexion or extension of the head may be achieved by the forceps when necessary.

Compression of the foetal head is an incidental accompaniment of every forceps application. It is comparable to the undesirable side effects that are inevitable with the use of certain drugs. Hence it must be kept to the minimum possible. A perfect cephalic application of the forceps to the foetal head compresses the head to the minimum. The oblique and anterior-posterior grasps on the foetal head are dangerous. It should also be noted that the amount of compression increases with the traction exerted. Lastly, since a flattening of the cephalic curve of the blades enhances the compression of the foetal head, the widest distance between the blades of the forceps should be at least 8.75 cm. and the cephalic curve of the blades should have a radius of 11.25 cm.

Forceps application may stimulate the uterine action when the patient is not under deep anaesthesia. This is not of much practical utility.

Forceps is said to dilate the cervix. But really speaking it merely stretches the cervix at the risk of tearing it during traction. Forceps should not be applied unless the cervix is fully dilated.

It is sometimes advised that a lateral lever action may be exerted during traction by carrying the handles from side to side.

This is not only of dubious benefit but may prove traumatic to the maternal soft parts. This procedure deserves to be condemned.

Indications for Forceps Delivery

Forceps delivery is a poor substitute for normal delivery. It should, therefore, be undertaken only if awaiting spontaneous delivery spells damage to the foetus or the mother. The following are the indications for forceps delivery:

(1) *Foetal Distress during second stage*—When the foetal heart sounds are slowed to less than 100 per minute or are increased to more than 160 per minute or become irregular the foetal life may be considered in jeopardy. Slowing of the foetal heart sounds spells greater danger to the foetus than increase in the heart rate; and irregularity of foetal heart sounds a greater danger than either of them. Foetal heart sounds must be recorded in between the contractions. Passage of meconium in presentations other than breech and tumultuous foetal movements are other signs of foetal distress. A judicious forceps delivery under the circumstances will spare the foetus further distress and save its life.

(2) *Delayed or prolonged second stage*—If the second stage lasts longer than two hours in a primipara or longer than one hour in a multipara it may be considered prolonged. Uterine inertia, rigid perineum, occipitoposterior position of the head, cephalopelvic disproportion, malpresentations like face or brow, and excessive sedation during the first stage of labour are important causes of prolonged second stage. A timely forceps delivery, when feasible, should usually forestall maternal and foetal distress. It should, however, be added that the clock should not be the sole criterion for deciding upon a forceps delivery. The duration of the second stage should always be considered in conjunction with the condition of the mother and the foetus.

(3) *Cutting short of a normal second stage*—Under certain conditions the mother or the foetus may not stand the strain of even a normal second stage of labour and it may be a great advantage to shorten the second stage or even eliminate it.

In severe pre-eclampsia there is a perpetual risk of the patient passing into eclampsia during the second stage. A judicious termination of the second stage minimises this risk.

If the mother is suffering from cardiac disease and especially if her heart has not stood the stress of pregnancy well, it is wise to shorten the strain of the second stage of labour.

In patients with a previous caesarean section, the uterine scar may give way during the second stage and is better spared of the strain of the second stage.

A premature baby stands the strain and stress of labour poorly and should not be allowed to linger on the perineum.

As soon as a cord prolapse during second stage is detected labour should be terminated in foetal interest.

(4) *Maternal distress in second stage*—A rising pulse, a dry tongue, and a rise in the body temperature indicate maternal exhaustion and distress. Intervention with forceps will relieve the mother of further strain.

(5) *Delivery of an aftercoming head*—According to many obstetricians an aftercoming head is best delivered by forceps. In any case, forceps delivery should be promptly undertaken at the slightest difficulty during the delivery of an aftercoming head which has passed the pelvic brim.

(6) *Prophylactic forceps*—In 1920 DeLee advocated an episiotomy followed by a prophylactic forceps delivery when the head is well down on the pelvic floor, is completely rotated anteriorly, and has begun to separate the levator ani. The advantages claimed by him are reduction in the strain of the second stage of labour, prevention of overstretching of the pelvic floor and sparing the foetal brain from prolonged compression. We feel that an episiotomy by itself suffices for the purpose and hence find no need for a routine use of the prophylactic forceps.

Prerequisites necessary for the use of forceps

The following conditions must be fulfilled before extraction of the head with the forceps is undertaken.

(1) *The cervix must be fully dilated*—If the cervix is not fully dilated it may get caught between the head and the blades of the forceps and get torn. Even if the blades are passed through the partially dilated cervix avoiding the catching of the cervical lip between the head and the forceps blade, the cervix is liable to be torn during traction with the forceps. Lastly, traction on the head through the undilated cervix may put undue strain on the supports of the uterus leading to future uterine prolapse.

(2) *Membranes must have ruptured*—An occasion for forceps delivery rarely arises prior to the rupture of the membranes. Besides rendering the diagnosis of the position of the foetal head

difficult, intact membranes encourage the slipping off of the forceps during traction. There is also a remote possibility of premature placental separation due to traction on the placenta through intact membranes during forceps extraction.

(3) *Head must be at or just above the spines*—The biparietal diameter ought to have descended to the level of the spines or at the most just above it for a safe forceps delivery. It is a sound practice not to attempt forceps delivery as long as any part of the head is palpable per abdomen.

It must be remembered that the assessment of the level of the biparietal diameter by noting the level of the lower pole of the head is very misleading, especially when there is a caput formation or a face presentation.

The aftercoming head must have descended into the pelvic cavity before forceps delivery is undertaken.

(4) *Midcavity and outlet contraction should be excluded*—There should be no disproportion between the lower pelvis and the foetal head. Dragging of the foetal head through a narrow outlet by brute force will result in intracranial damage.

(5) *Malposition should be corrected*—Malposition of the head, if present, should be corrected and the occiput—the chin in face presentation—rotated anteriorly before extraction with forceps is begun. Under exceptional circumstances, like a very low head in an anthropoid pelvis, a face-to-pubis delivery may be decided upon.

(6) *Uterine contractions must be present*—Forceps extraction in the face of complete uterine atony has been frowned upon for fear of post-partum haemorrhage. Besides, absence of uterine contractions would necessitate much greater traction during forceps delivery.

(7) *Bladder and rectum should be empty*—A full bladder is liable to be traumatised, directly or indirectly, during forceps extraction. Bladder should be emptied by catheterisation before proceeding with forceps application. If the rectum is not empty, faecal matter gets expelled during the extraction of the head and seriously interferes with asepsis. A simple enema should be given every 12 hours to all cases of prolonged labour to ensure the rectum being empty at the time of delivery.

(8) *Anaesthesia should be adequate*—Unless the patient is properly anaesthetised one should not proceed with the application of the forceps. Besides causing pain and discomfort to the patient and great inconvenience to the obstetrician, a forceps delivery

under inadequate anaesthesia will inflict mental trauma to the patient who, as a result, may dread future pregnancy and labour.

Fundamentals of Forceps Delivery

The operation of extraction of the head by the forceps consists of two parts viz., application of the blades and exertion of the traction.

(1) *Application of the blades*—Proper application of the blades is the essence of forceps delivery. When correctly applied to the head the blades lie by the side of the foetal head along a line running from the chin to a point between the anterior and posterior fontanelles 1.5 cm. (or a finger's breadth) from the latter (Figs. 189, 190). The sagittal suture should be perpendicular to



Fig. 189. Correct cephalic application of the blades in occipito anterior position.



Fig. 190. Correct cephalic application of the blades in occipito posterior position.

the middle of the plane of the shanks. If the sagittal suture cuts the plane of the shanks obliquely it indicates an oblique grasp of the head, like a brow-mastoid grasp, instead of the biparietal one (Fig. 191). Difficulty in locking the blades also indicates an oblique grasp of the head. When the head is obliquely grasped the blades tend to slip off the head during traction. Traction with the forceps grasping the head obliquely is likely to result in intracra-



Fig. 191. Oblique application of the blades to the foetal head (Brow-mastoid grasp).

nial injury to the foetus. When the shanks of the blades are more than a finger's breadth away from the posterior fontanelle towards the anterior fontanelle, the head will tend to extend during traction. Lastly, the blades should be inserted deep enough for its tips to be anchored well below the malar eminence as otherwise they may tend to slip off the head during traction. Hence, after the blades are locked, fenestration should hardly be felt beyond the scalp by the examining finger.

Just as the forceps should be correctly applied to the foetal head, it is also necessary that they should be correctly applied with reference to the maternal pelvis. An ideal position of the forceps in the pelvis is a one where the blades are placed transversely in the pelvis with their pelvic curve lying along the curve of Carus. When internal rotation of the head is complete, an application of the forceps which is ideal with reference to the head is also ideal with reference to the pelvis. With the head incompletely rotated, forceps blades properly applied with reference to the head will lie more or less obliquely in the pelvis. But, although the head should never be grasped obliquely by the forceps an oblique application of the forceps with reference to the pelvis is safe within certain limits. This safety range for the movement of the forceps blades within the pelvis is limited by the iliopectineal eminence anteriorly and the sacroiliac joint posteriorly. Thus, when the sagittal suture is within 45 degrees of the sagittal plane an application of the forceps ideal with reference to the head and yet safe with reference to the pelvis can be achieved. But, when the sagittal suture is beyond 45 degrees of the sagittal plane, as happens when the head is transverse or nearly so, it is mandatory to rotate the head prior to its extraction by the forceps.

(2) *Exertion of traction*—Before exerting traction one must ensure that the blades are properly applied and that no part of maternal tissues is gripped between the blade of the instrument and the foetal head. The direction of traction should always be at right angles to the plane of the pelvis at the level of the head. In other words, the head should be pulled along the curve of Carus. At the vulval outlet, the normal mechanism of labour should be duplicated by encouraging extension in vertex presentation and flexion in face presentation.

Traction should be employed only during a uterine contraction. In between the contractions, the handles should be slightly separated, without actually unlocking the blades, so as to release the compression of the foetal head. Traction should be exerted by a continuous steady pull and never by intermittent jerky pulls. Too powerful a traction is neither safe nor necessary. The force exerted by the muscles of the forearms is usually adequate. If this force is found insufficient, malposition of the head, improper application of the blades and cephalopelvic disproportion should be thought of and looked for.

Technique of Forceps Delivery

Low-forceps Operation. The biparietal diameter has passed the ischial spines and the occiput is more or less completely rotated forwards. Axis traction instrument is not necessary and either a long curved forceps or a short curved forceps may be employed. Majority of the forceps operations are of this type. Low forceps delivery is usually easy and uncomplicated.

The patient is placed in lithotomy position. The bladder is emptied by catheterisation. The vulva and the surrounding skin are painted with dettol lotion. The patient is draped with sterile towels leaving the vulval area exposed.

If the head is very low perineal infiltration with 1 per cent novocaine is adequate anaesthesia. In other cases pudendal block anaesthesia should be employed.

Before proceeding with the application of the forceps a thorough vaginal examination is undertaken to confirm the full dilatation of the cervix, to reassess the level and the position of the head and to exclude any pelvic abnormality. Foetal heart sounds are noted and are constantly kept under watch throughout the operation.

In a primipara an episiotomy will invariably be required during the extraction of the head and it may conveniently be done before application of the blades.

Since the lock is on the upper surface of the shank of the left blade and on the lower surface of the shank of the right blade, the left blade should be applied first so as to facilitate the locking of the blades.

When the occiput is anterior, the left blade is grasped by the handle by the left hand and is inserted to the left side of the pelvis so as to lie along the left side of the foetal head. Four fingers of the right hand are gently introduced between the head and the posterior vaginal wall with their palmer surfaces towards the head. The handle of the left blade is grasped between the thumb and index and middle fingers (a pencil grip) of the left hand and held vertically at the vulva. The blade is now gently introduced between the head and the posterior vaginal wall along the palmer surface of the fingers of the right hand. This is achieved by carrying the handle downwards and backwards. Once the widest part of the blade is well in contact with the head further insertion of the blade is accompanied by a gentle sweeping of the blade over the head so as to bring it to lie along the left side of the head. The fingers of the right hand guide the blade during this sweeping movement. During this manoeuvre the handle of the blade has to be moved over an arc, at first outward towards the right thigh and then inward towards the midline. When the introduction of the blade is completed the shank comes to lie over the perineum near the midline. In connection with the introduction of the blades two things cannot be emphasized too strongly. The first is that throughout the procedure the tip of the blade should constantly be kept in contact with the scalp. This is the surest way of preventing damage to the vaginal walls and the fornices and a guarantee against catching a rim of the cervix between the blade and the head. The second thing is that skill rather than force is required for these manipulations.

The handle of the left blade is now steadied by an assistant while the right blade is introduced in a like manner. The right blade is grasped by the handle by the right hand and is inserted to the right side of the pelvis so as to lie along the right side of the foetal head. When the right blade is in place its shank crosses that of the left blade from above.

The two handles are now grasped, one in each hand, and the instrument locked by adjusting the slots on the shanks.

Direction of traction should at first be downwards and backwards but as the head descends it should gradually change through horizontal to upwards and forwards. An episiotomy, if not already made, should be made when the perineum is stretched by the head. When the head is crowning the delivery of the head may be completed by gradual extension of the head by elevating the handles forwards and upwards. Some obstetricians choose to remove the forceps once the biparietal diameter is delivered and then to complete the delivery of the head by the Ritgen's manoeuvre as in spontaneous labour. However, before removing the blades one must ensure that the biparietal diameter is born outside the vulva. *While removing the blades, the handles, after unlocking, are carried over a wide arc to the opposite groin so that the blades gently sweep across the foetal scalp without traumatising maternal tissues.*

Low-mid Forceps Operation. In low-mid forceps delivery the head is at a higher level than in low forceps delivery and though often more or less completely rotated it may be only partially rotated. Perineal infiltration anaesthesia is inadequate and pudendal block anaesthesia is necessary. Short curved forceps is unsuitable as traction exerted by it is not much. Hence, a long curved forceps should be employed. The use of axis-traction devices is usually not required. The techniques of application of the blades and the extraction of the head are the same as in low forceps operation (Fig. 192).

If the head is not well flexed the handles should be elevated forwards before locking so as to obtain a correct cephalic placement of the blades.

It may be necessary to adjust the position of one or both of the blades to facilitate their locking. Difficulty in the locking of the blades or divergence of the handles inspite of locking indicates an oblique gripping of an incompletely rotated head. On re-examination if the head is found to be incompletely rotated the blades should be readjusted or reapplied so as to obtain an accurate cephalic application. The blades would necessarily have to occupy an intermediary position between the transverse and oblique diameters of the pelvis. During traction the head will spontaneously rotate and the blades will come to lie in the transverse diameter of the pelvis.

Mid-forceps Operation. As the head is in the midcavity

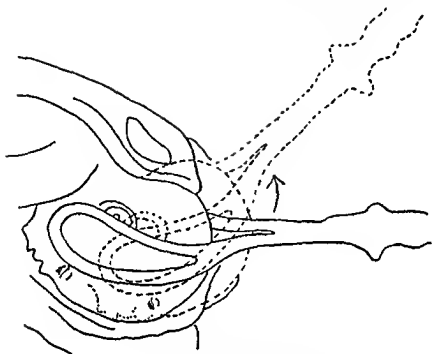


Fig. 192 Changing direction of traction during the latter part of forceps extraction.

it is usually incompletely rotated or not rotated at all. In fact, in many cases there is a deep transverse arrest or a persistent occipito-posterior position. If the rotation of the head is nearly complete the operation does not differ much from the low-mid forceps operation and can be performed under pudendal block anaesthesia. The employment of axis-traction device is, however, necessary. When the head is unrotated and malposed, rotation of the head and correction of the malposition as described later should precede the extraction of the head. For rotation of the head by forceps pudendal block anaesthesia is adequate but for manual rotation of the head general anaesthesia is necessary. Axis-traction forceps should be employed for extraction of the head.

Neville's axis-traction forceps is easy to handle. The fact that the axis-traction device is to be attached after the blades are applied and locked is a great advantage especially when axis-traction is unexpectedly called for during the extraction of the head. The axis-traction device can be very easily fitted to the handles and

also acts as fixation screw to hold the blades together. The direction of traction is indicated by an arrow on the axis-traction device. Prior to removal of the blades the axis-traction device should be unscrewed and removed.

In *Milne Murray's axis-traction forceps* traction rods have to be fitted to the blades prior to their application. The left blade is inserted first with its traction rod kept close to but behind the shank. After application of the blade the traction rod is allowed to hang down while the handle is steadied by an assistant. The right blade is now inserted with its traction rod in front of the shank. After the blades are locked the traction rod of the right blade is allowed to hang down behind the shank. The handles of the two blades are now held together by the fixation screw. The traction rods are now joined together by the traction handle. During extraction of the head the traction rods should lie close behind but parallel to the shanks to ensure traction on the head in the axis of the pelvic canal. In between the tractions the fixation screw is loosened to release the compression of the head. As the head descends the handles of the blades gradually move forwards and upwards. A ball and socket joint on the traction handle ensures that the rotation of the head is not hampered during traction. While removing the blades the traction handle is detached, the fixation screw is released, the traction rod of the right blade is carried in front of the shanks and then the blades taken off in the usual manner.

High-forceps Operation. In modern obstetrics high-forceps delivery is almost a taboo. The only occasion when one might reluctantly undertake it, is when at the end of manual rotation of the head the biparietal diameter is found displaced upwards almost upto the brim. The patient is already under general anaesthesia. The blades should be carefully applied under the guidance of the hand which after rotating the head is maintaining it in corrected position. Axis-traction forceps must be employed. If any difficulty arises during the application of the blades or the extraction of the head, it is prudent to give up attempts at forceps delivery and resort to caesarean section.

Outlet-forceps Operation. When the head is almost crowning forceps operation may be necessary for foetal distress. With the head so low at the vulval outlet employment of the short curved forceps in the usual fashion is both cumbersome and unnecessary. In such situations the short straight forceps can be used with ad-

vantage. The insertion of the blades is done directly along the side of the foetal head. No anaesthesia is required for this procedure although in most of the cases perineal infiltration anaesthesia would already have been given for purposes of the episiotomy.

Forceps Delivery in Posterior and Transverse Positions of the Vertex

When there is persistent occipito-posterior presentation or deep transverse arrest forceps delivery requires great judgement in the choice of the operative procedure adopted and calls for expert skill in the proper execution of that procedure. In fact, half the cases of failed forceps stem from malpositions of the head. Once cephalopelvic disproportion is excluded and it is decided that the case is suitable for forceps delivery one has to choose from a variety of procedures given below. The choice depends on many considerations the important ones being the position of the occiput, the level of the head, the architecture of the pelvis and the obstetrician's experience of and prejudice for or against a particular procedure.

(A) *Forceps extraction of the head as face-to-pubis or occipito-posterior*—As a rule the occiput should be rotated anteriorly before extraction by the forceps. However, in an anthropoid pelvis a face-to-pubis delivery is neither dangerous nor disadvantageous and may be selected as a procedure of choice. In fact, in anthropoid pelvis spontaneous face-to-pubis delivery is not unusual. Secondly, when the head with its occiput directly posterior is very low in the pelvis, almost on the perineum, a face-to-pubis delivery can be safely undertaken in any variety of normal pelvis. In these latter cases rotation of the head to an anterior position is neither necessary nor worth the trouble.

Pudendal block anaesthesia is adequate for the operation. The blades are applied as usual so as to achieve a correct pelvic application which will automatically correspond to correct cephalic application as the head is completely rotated although posteriorly (Fig. 193). The traction should at first be downwards and backwards and gradually change to horizontal as the head descends. When the forehead comes under the pubic arch the handles should be gradually elevated forwards and upwards so as to deliver the occiput over the perineum whereafter the handles should be depressed to cause extension of the head and to deliver the forehead and the face from under the pubic arch. In face-to-pubis delivery

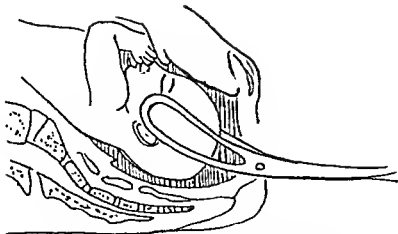


Fig. 193. Face-to-pubis delivery with forceps.

an episiotomy must be done as otherwise the perineum is liable to be torn badly.

(B) *Manual rotation of the head and forceps extraction*—This was formerly considered the treatment of choice. It consists in grasping the head by the hand and rotating the occiput forward. Now the forceps blades are applied to the corrected head and it is extracted. The present tendency is to prefer forceps rotation to manual rotation for various reasons. In the first place, manual rotation requires general anaesthesia whereas pudendal block is adequate for forceps rotation. Secondly, a manually rotated head tends to revert back to its original position while forceps blades are being applied for extraction. Forceps rotations are free from this difficulty. Lastly, the greatest disadvantage of manual rotation is the fact that during the procedure the head is invariably displaced upwards and one is very often forced to undertake a high forceps application and difficult extraction. In fact, when the head happens to be displaced above the pelvic brim it may refuse to enter the brim in occipito-anterior position.

General anaesthesia is necessary for manual rotation of the head. The operation is carried out with the patient in the lithotomy position. Right hand is employed for rotation when the occiput is to the mother's left and the left hand when it is to the mother's right. The whole hand is introduced in the vagina and a thorough examination is done to confirm the position of the head and its level in the pelvis and to study the architecture and the capacity of the pelvis. It is essential to flex the head as much as possible as a well flexed head will present its least dimensions and

make the rotation easy. The occipital pole of the head is grasped by spreading four fingers over the posterior parietal bone and the thumb over the anterior parietal bone. The head is now rotated by a movement of pronation of the forearm so as to bring the occiput forwards by the shortest route. The head should be overcorrected so as to carry the occiput across the midline to the opposite side as a safety measure against the tendency of the head to revert towards its original position during subsequent application of the forceps. The other hand should grasp the anterior shoulder per abdomen and rotate the foetal trunk synchronously and simultaneously with the rotation of the head. Rotation of the mere head, unaccompanied by the rotation of the trunk, is likely to result in the twisting of the neck with a great tendency for the head to revert back to its original position. Great care should be taken throughout the procedure to keep the upward displacement of the head to a minimum.

The next step of the operation is forceps extraction of the head. Axis-traction forceps should be employed. A blade of the forceps is applied in the usual way guided by the rotating hand while the hand is still grasping the head at the end of the rotation. In left-sided positions of the occiput the right hand is employed for rotation and the left blade of the forceps is applied first as is usual. But in right-sided positions of the occiput the left hand is employed for rotation and the right blade of the forceps is applied first. This necessitates some manoeuvring of the handles of the blades during locking. During the application of the second blade an assistant holds the first blade firmly in position.

(C) Scanzoni's manoeuvre—The conventional long curved forceps is employed for rotating the occiput. The forceps are applied correctly to the foetal head—cephalic application—but with the concavity of the pelvic curve towards the sinciput. The rotation of the head is achieved by moving the handles widely through the arc of a circle so that the tips of the blades inside the vagina move through as small a circle as possible. Under no circumstances should the rotation be attempted by simply twisting the handles like a key in the lock, for then the tips of the blades inside the vagina would move through the arc of a larger circle and cause vaginal lacerations and tears. After the rotation is completed the concavity of the pelvic curve of the forceps will be towards the sacrum, reapplication of the forceps being necessary for the extraction of the head. The right blade of the forceps which

is towards the mother's left is removed and replaced by the left blade of another pair of forceps while the other blade is being held in situ to prevent reversal of the head to posterior position. This other blade which is towards the mother's right is now replaced by the right blade of the second instrument. After the blades are locked and the axis-traction attachment fixed, one proceeds with the extraction of the head.

It is obvious that Scanzoni's manoeuvre, unless carried out very meticulously, is prone to cause vaginal tears. The necessity of double application of the forceps is another great disadvantage of the manoeuvre. This manoeuvre is not much employed today.

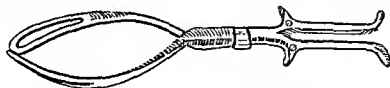
(D) *Kielland's forceps*—This forceps though originally devised for deep transverse arrest is now also used for occipito-posterior positions and face presentations. With this instrument a true cephalic application can be obtained irrespective of the position of the occiput, asynclitism of the head can be corrected if necessary, the head can be rotated by just twisting the handles with a key-in-a-lock movement, and the head can be extracted without resorting to reapplication of the blades.

The instrument has a small pelvic curve and has a bayonet-like shape when viewed from the side (Fig. 194). The shanks over-



Fig. 194. *Kielland's forceps, side view.*

lap and are so articulated as to permit the sliding of one blade over the other (Fig. 195). This sliding lock is designed to deal with asynclitic heads.



195. *Kielland's forceps, front view.*

In occipito-transverse position of the head the anterior blade can be applied by one of the three methods. (1) The classical or

original method—In this, the blade, with the concavity of its cephalic curve anteriorly, is inserted between the symphysis and the head. It is now rotated, rather twisted, through 180 degrees in the direction indicated by a knob on the anterior surface of the handle. This brings the concavity of the cephalic curve in apposition to the foetal head. This classical method is no longer favoured. (2) Wandering or gliding method—This method is most widely employed. The blade is first inserted posteriorly and then glided over either the face or the occiput to bring it anteriorly in position. (3) Direct application—The blade with the concavity of its cephalic curve towards the head is inserted between the symphysis and the head.

The posterior blade is now inserted and the blades locked. The head should now be disimpacted and the rotation carried out a little above the level of arrest. However, in certain types of pelvis where the sacrum is flat and the posterior segment shallow, it is advantageous to pull the head as occipito-transverse lower down in the pelvis and then rotate it there. In any case, rotation and traction should not be simultaneously carried out by the forceps as it will result in spiral tears of the vagina. Of course, if during traction as occipito-transverse if the head tends to rotate by itself the rotation need not be hindered.

Forceps Delivery in Face Presentation

Indications for forceps delivery in face presentation are the same as those in vertex presentation. Since delivery in persistent mento-posterior position is impossible, in such cases the chin ought to be rotated forwards either by the forceps or manually before extraction. The mode of application of the blades is identical to that in vertex presentations. Due care should however be taken so that the delicate face is not traumatised by the blades. The position of the blades along the face should approximate occipito-mental diameter as far as possible (Fig. 196). To achieve this the handles of the blades should be elevated forwards before locking them. The handles should now be depressed to achieve extension of the head, the essence of mechanism in face delivery. The direction of traction should at first be downwards and backwards, then horizontal till the chin is delivered from under the symphysis pubis and lastly forwards and upwards to complete the delivery of the face by flexion of the head.



Fig. 196. Forceps application to face presentation.

Forceps Delivery of Aftercoming Head

Forceps extraction of the aftercoming head has a decisive advantage over the traditional methods like Burns-Marshall or Jaw-shoulder traction viz. the traction force is exerted directly on the head instead of through the cervical spine. Hence, forceps should be employed whenever the delivery of the aftercoming head is difficult. Though Piper's forceps with long shanks having perineal curve is best suited, ordinary long curved forceps is adequate.

It should be emphasized that when the head is above the brim application of the blades is extremely difficult and forceps extraction most unlikely to succeed. Hence, unless the head has passed down the brim forceps should not be employed.

The forceps should be applied along the ventral aspect of the child to promote flexion of the head (Fig. 197). When the occiput is anterior an assistant holds the trunk forwards out of the way while the blades are being applied in the usual manner along the ventral aspect of the foetus. Traction should be exerted at first downwards and backwards, then horizontally and lastly upwards and forwards. When the occiput is posterior the forceps may be applied along the dorsal aspect of the baby (Fig. 198).

Failed Forceps

The term failed forceps is employed when attempts at forceps delivery end unsuccessfully.

The commonest cause of failure of forceps delivery is malposition of the head. It sometimes becomes very difficult to diagnose occipito-posterior and occipito-transverse positions and the pitfalls in their diagnosis are discussed in an earlier section.

Another important cause is premature application of the for-

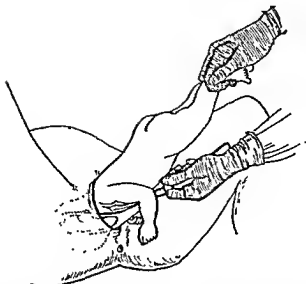


Fig. 197. Forceps delivery of the after-coming head (occipito-anterior).



Fig. 198. Forceps delivery of the after-coming head (occipito-posterior).

ceps before the cervix is fully dilated. Although only an immature obstetrician would venture a forceps delivery through an incompletely dilated cervix, the presence of a cervical rim often becomes

apparent only when general anaesthesia is administered for forceps delivery.

Cephalopelvic disproportion is no longer an important cause of failed forceps that it used to be about 40 years back. Nevertheless, outlet contraction is often overlooked until attempts at forceps extraction fail and minor degrees of hydrocephalus are easily missed when the wide sutures are partly obliterated during labour.

A contraction ring gripping the neck of the foetus is occasionally responsible for unsuccessful forceps extraction.

Abnormal presentations like face and brow are some of the other causes of failed forceps.

The management of a case of failed forceps will essentially depend on its cause. But the condition of the foetus and the mother must also be taken into consideration. Whenever an attempt at forceps delivery is fruitless a careful search should be made to find out the underlying cause. When malposition of the head is the underlying cause, allowing time for spontaneous rotation or correcting the malposition, manually or by forceps, would be the right course unless foetal heart sounds have disappeared, in which case, craniotomy should be preferred. Incompletely dilated cervix is best managed by awaiting for full dilatation unless immediate delivery by caesarean section or Duhrssen's cervical incisions is indicated by the condition of the mother or the foetus. An outlet contraction is best dealt by an abdominal delivery except when the foetus is already dead in which case craniotomy should be undertaken. In exceptional cases the use of symphysiotomy might be considered judicious. In case of hydrocephalus the cerebrospinal fluid should be tapped by a trocar and canula. A constriction ring may yield to amyl-nitrite inhalation, failing which, caesarean section may have to be employed.

In hospital practice, it is not so rare in our country to be called upon to deal with patients who have been subjected to attempted forceps delivery. In many of them the foetus is already dead or dying when first seen. The foetal mortality in cases of failed forceps is as high as 35 per cent. The mother is not free from risk either and may on admission be found dehydrated, infected, shocked and traumatised even to the extent of uterine rupture.

Dangers of Forceps Delivery

Forceps delivery when undertaken with skill and care is safe. But if the operation is performed when the necessary prerequisites

are not fulfilled or is carried out carelessly or crudely, it is full of dangers both to the mother and the foetus. Maternal damage includes lacerations and tear of the vagina and vulva; perineal tears, sometimes complete; colporrhexis; tears of the cervix and rupture of the uterus. Tears of the vaginal walls might extend into the bladder or rectum causing fistulae. Postpartum haemorrhage, either traumatic or atonic, and sepsis pose additional dangers to the mother.

Intracranial haemorrhage, tears of the tentorium cerebelli, fractures of the skull, cephalhaematoma, compression of the umbilical cord between the blade and the head, trauma to the facial nerve leading to Bell's palsy and damage to the baby's face and eyeball are the various traumas that might be inflicted on the baby during forceps delivery. Foetal mortality is 3-4 times greater in forceps deliveries than in spontaneous deliveries. Most of the foetal damage is done by grasping the head obliquely or, worse still, antero-posteriorly (Fig. 199). High forceps deliveries, forceps rotations

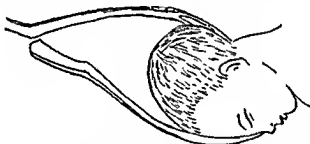


Fig. 199 Antero-posterior application of the blades to the foetal head (occipitofrontal grasp).

by the inexperienced and slipping of the forceps off the foetal head are particularly risky for the mother and the foetus.

CHAPTER 9

VACUUM EXTRACTOR (VENTOUSE)

During the last 250 years numerous attempts have been made to replace forceps extraction by traction through a suction applied to the foetal head. However, Malmstrom's modified instrument seems to be the first really successful vacuum extractor (Fig. 200).

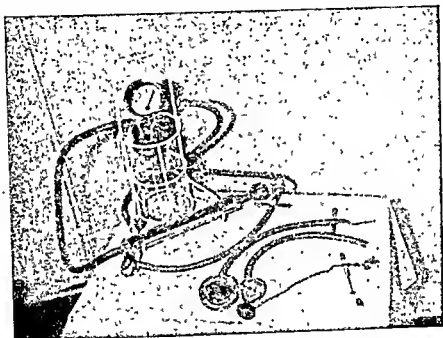


Fig. 200. Malmstrom's vacuum extractor.

An important feature of this instrument is the application of suction and traction through a metal cup so designed that when the suction is created an artificial caput (chignon) is formed within the cup which holds firmly and allows adequate traction. The metal cup is 20 mm. deep and is available in 3 sizes viz. 40, 50 and 60 mm. in diameter. From a metal plate inside the cup a chain, covered by rubber tubing, passes to a traction bar where it is to be secured by a pin. Another rubber tubing connects the metal tube traversing the traction bar to the vacuum bottle. This bottle carries a manometer graduated upto 1 kg/cm^2 , has a screw release valve, and is connected to a vacuum pump. The two larger cups carry

a small knob which not only indicates the rotation of the head during traction but can also be used to assist rotation. The rubber tubing conveys the vacuum while the chain transmits to the cup the traction exerted at the traction bar.

Anaesthesia

Although the instrument can be used without anaesthesia most of the authors have advocated perineal infiltration or pudendal block anaesthesia.

Application

The instrument is usually used in the second stage. But it can be used even during the first stage after half dilatation of the cervix to augment uterine contractions and promote cervical dilatation. Membranes must be ruptured before its application.

It is best used in vertex presentations but can be used on the breech. In the latter instant the cup should be applied to the anterior buttock with due precautions to avoid the genitalia being caught in the cup.

The largest possible cup should be employed and should be attached as near the occipital end of the head as possible so as to promote flexion during traction (Fig. 201). Vaginal or cervical tissue must not get caught between the scalp and the cup. The vacuum should be gradually created over a period of 6-10 minutes. The maximum permissible safe vacuum is 0.8 kg./cm.^2 Traction is best exerted during the pains and in the axis of the pelvis. The total time during which the cup is attached to the scalp should not exceed 45 minutes. After the head is extracted the screw valve on the vacuum bottle should be released to nullify the vacuum and allow the detachment of the cup from the scalp.

Indications

The indications for the use of the vacuum extractor are the same as those for forceps extraction. It is however unsuitable when there is acute foetal distress or cephalopelvic disproportion. Hypotonic inertia during the first stage may be considered an added indication.

Advantages and disadvantages

The safety of the instrument both to the mother and the foetus has been widely acknowledged. The risk of sepsis is minimal. No

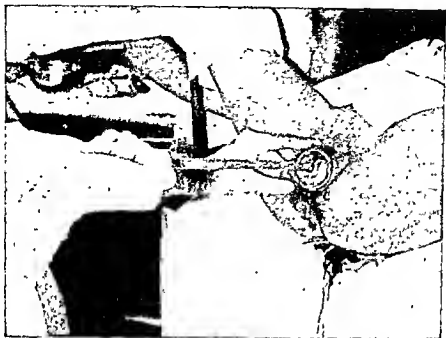


Fig. 201. Delivery with vacuum extractor.

part of the instrument encroaches on the pelvic space available for the passage of the foetus. The large artificial caput on the foetal head (chignon) rapidly diminishes in size and usually disappears within few hours. The only possible foetal complication is the occasional formation of a cephalhaematoma. Its great advantage over the forceps is that it can be used during the first stage to augment pains and hasten cervical dilatation. The time required for its application is a disadvantage in cases of acute foetal distress. It is claimed that the rotation of a posterior or a transversely arrested head can be more easily and more safely accomplished than with the forceps. Rosa has calculated that compression of the foetal head by a vacuum extractor is $1/20$ th of that caused during forceps deliveries. The vacuum extractor is a very valuable addition to the obstetrician's armamentarium. It can replace forceps deliveries, especially the difficult and complicated midforceps ones. In fact, in many continental clinics it has already displaced the for-

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CHAPTER 10

SYMPHYSIOTOMY AND PUBIOTOMY

In *symphysiotomy*, the pubic joint is divided to bring about an increase in the capacity of the bony pelvis sufficient to allow the delivery of a living child.

In *pubiotomy*, an enlargement of the pelvis is brought about by severing the pubic bone on one side of the symphysis pubis by means of Gigli saw.

The operation of symphysiotomy on the living was first performed in France by Sigault in 1777. It retained its popularity only for a few years. Its two chief disadvantages are: (1) loss of natural support to the urethra and the bladder in the midline incision, and (2) wound through the cartilage is very prone to infection. To overcome these, Gigli, in 1893, proposed that the incision should be made through the pubic bone itself, as by this means the supports of the urethra and the bladder are undisturbed and also the severed bone would heal more rapidly and firmly. The first operation of pubiotomy was performed by Gigli in 1902.

Indications. The only indication in present-day obstetrics is outlet contraction; the transverse diameter of the outlet being less than 9.5 cm. In hospital class of women in India, the birth weight of the babies is usually less than six pounds and spontaneous delivery occurs through a bi-ischial transverse diameter measuring 9.0 cm. The usefulness of pubiotomy is in those cases where the head is arrested at the outlet and cannot be delivered with forceps.

Pubiotomy

Steps Open Method:

(1) The bladder is emptied by a catheter immediately before the operation.

(2) The legs are held by assistants and not tied as in lithotomy position.

(3) An incision, 2½ cm. long, is made just above the upper margin of the pubic bone extending medially from the pubic spine. The incision is deepened down to the bone through the periosteum.

(4) A finger is passed into the wound and all the tissues are separated from the posterior surface of the bone.

(5) The finger is kept in position and a Doderlein pubiotomy needle is guided along the posterior surface of the pubic bone and, when the inferior margin is reached, the handle of the needle is rotated so that the tip of the needle is felt through the upper and outer part of the labium majus. A small incision is made over the tip and the eye of the needle is brought out (Figs. 202, 203).

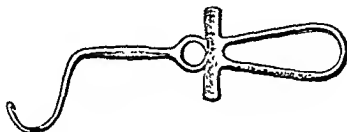


Fig. 202. Doderlein pubiotomy needle.

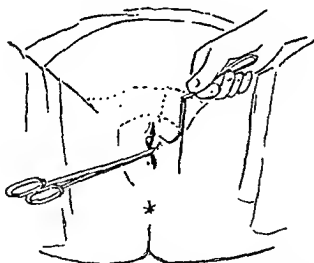


Fig. 203. Pubiotomy needle is guided along the posterior surface of the pubic bone.

(6) A fine wire saw is threaded and the needle is withdrawn through the upper incision. The handles are attached to the saw and the bone is then sawed through. The saw should be kept straight during sawing (Fig. 204). The saw is then withdrawn.

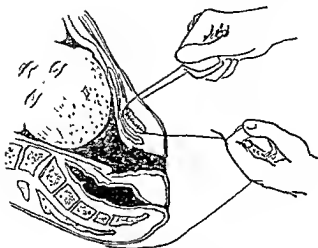


Fig. 204. Sawing of the pubic bone.

- (7) Free bleeding occurs from both the wounds, but is readily controlled by firm pressure with a gauze pad.
- (8) Immediate delivery is effected with forceps.
- (9) After dressing the wounds, it is necessary to immobilise the pubis for a few days by strips of adhesive plaster.

Subcutaneous Method:

- (1) Through a very small incision over the upper margin of the pubic bone, the needle is guided blindly and brought out as described above.
- (2) The labium majus is held medially and a small incision is made just below the inferior margin of the pubic bone. The tip of the needle is inserted through this wound and, with the guidance of a finger in the vagina, it is kept close to the bone and brought out. The pull on the labium majus is now released.

Symphysiotomy

Steps

- (1) A small incision is made just above the symphysis pubis.
- (2) A narrow blade knife is pushed down with the flat of the blade in close contact with the joint.
- (3) The blade is then turned through a right angle so that

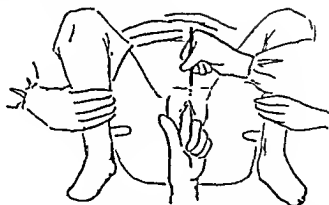


Fig. 205. The knife in position to cut the symphysis pubis.

the cutting edge is directed through the joint. The joint is then partially divided (Fig. 205).

(4) By abducting the legs, the joint is divided completely.

CHAPTER 11

CRANIOTOMY

In the puerperal era, craniotomy was the sheet anchor in the management of all cases of obstructed labour. With the development of obstetric science during the last 350 years, the incidence of craniotomy has gradually decreased. The greatest decline has been during the last 25 years, thanks to the increased safety of caesarean section.

In present-day obstetrics, the operation of craniotomy is in most cases a perforation of the head alone. Those cases which are likely to require further reduction in the size of the head by crushing are preferably delivered by caesarean section. However, in rural obstetric practice, the need for cephalotripsy still exists.

It should be realised that craniotomy is not indicated in every case where the death of the foetus occurs during labour or the foetus is in a moribund state. Many such cases deliver either spontaneously or following correction of an abnormal presentation or position. Craniotomy becomes imperative, (1) when labour has been obstructed and the foetus is dead or is moribund, and (2) on a living child, in the interests of the mother, when facilities for caesarean section do not exist.

Incidence. From the table below, it can be easily seen that during the last 25 years the incidence of craniotomy has been re-

Table
Incidence of Operative Deliveries at the N.W.M. Hospital

	Viable con- fine- ments	Cranio- tomy	Caesa- rean Sections	Forceps Delive- ries	Mater- nal Mortality in Cra- niotomy cases
1st January 1934 to 31st December 1939	20,248	101 (0.34%)	144 (0.49%)	379 (1.29%)	14 (13.0%)
1st August 1954 to 31st July 1959	53,445	113 (0.21%)	822 (1.55%)	954 (1.60%)	5 (4.4%)

duced to two-thirds, whereas that of caesarean section has been trebled, and that of forceps delivery appreciably increased.

The incidence varies according to the available obstetric facilities in the area served by the institution. Kushner and Posner in 1945 report 19 craniotomies in 22,705 deliveries, an incidence of 0.084 per cent. Long and Stabnick report 29 craniotomies in 12,292 deliveries, an incidence of 0.235 per cent.

Indications. *Hydrocephalus.* It is a positive indication for craniotomy, an unavoidable one in obstetric practice anywhere. A forecoming hydrocephalic head is frequently diagnosed before the onset of labour or early in labour, but the inexperienced may mistake a hydrocephalic head for a breech presentation and the diagnosis may not be made until the labour is delayed or obstructed. A hydrocephalus presenting as a breech usually remains undiagnosed until failure at attempts to deliver the aftercoming head. Spina-bifida when present gives a clue to the diagnosis of hydrocephalic aftercoming head.

Cephalopelvic Disproportion. Cephalopelvic disproportion may cause arrest of the head at the brim, in the cavity or at the outlet. Disproportion at the brim is usually recognised early in labour, even by the inexperienced, and abdominal section performed. On the other hand, disproportion in the cavity or at the outlet is frequently not diagnosed until late in labour and the patient is brought to the hospital with the child already dead or in a moribund state. A number of such cases are admitted after "Failed" forceps delivery. In the N.W.M. Hospital series of 113 cases there were 29 cases of cephalopelvic disproportion in addition to 5 cases of outlet contraction.

Malpresentations and Positions. Craniotomy is necessary for malpresentations diagnosed very late in labour with the foetus dead. In this series, there were 9 cases of malpresentations—4 of persistent brow presentation, 2 of persistent mento-posterior and 3 of persistent occipito-posterior.

Compound Presentations. Neglected compound presentations detected late in labour are best treated by craniotomy as forcible attempts to manually correct the compound presentation is not only unlikely to be successful but carries the danger of rupture of the uterus. In this series, there were 9 cases of compound presentation.

Arrest of Aftercoming Head. When the aftercoming head is arrested because of cephalopelvic disproportion, there is no alternative but to perform a craniotomy. When the aftercoming head

is arrested because of an incompletely dilated cervix, it need not be perforated as spontaneous delivery can be expected by waiting for further dilatation to occur.

Failed Forceps. When forceps have failed but the foetus is alive and well, caesarean section is the method of choice but, when the foetus is moribund or already dead, craniotomy has to be considered. Not all the cases of failed forceps need craniotomy for vaginal delivery to occur. When forceps delivery has been attempted through an incompletely dilated cervix there is no need to perforate the head. Waiting for some hours after an injection of 100 mg. pethidine hydrochloride usually results in spontaneous vaginal delivery.

To Spare the Strain on Caesarean Scar. When the previous caesarean section has been performed for cephalopelvic disproportion and the foetus dies unexpectedly during the first stage of labour, it is wise to perforate the head when the cervix is almost fully dilated. In this series, there were 2 such cases and both delivered spontaneously after the head was perforated.

Technique of Craniotomy

Perforation of a Hydrocephalic Head. (a) *When it is Presenting by Head.* Rarely a hydrocephalic head is inaccessible vaginally, and abdominal tapping advocated by Walsh in 1933 has to be done. It is tapped vaginally with a trocar and cannula. A hydrocephalus diagnosed during pregnancy is tapped soon after the onset of labour with the cervix barely one finger dilated. After tapping, labour is allowed to progress naturally and spontaneous delivery can usually be expected.

(b) *When it is Presenting as Breech.* As mentioned, the condition is seldom diagnosed before the aftercoming head is arrested. A hydrocephalic aftercoming head is more likely to be inaccessible vaginally but then it can be easily tapped through the spinal canal after deliberately opening it by a transverse incision in the upper dorsal region. A stiff gum elastic catheter is passed up into the ventricles to tap the fluid. Should there be associated spina bifida, the catheter is passed up the open spinal canal.

Perforation of normal head. *Above the Brim.* When the head is above the brim, anaesthesia should be given not only to spare the discomfort to the patient but also to facilitate the performance of the operation.

The head must be well fixed during perforation to avoid maternal injury caused by slipping of the perforator off the head. This is done by an assistant grasping the head through the abdominal wall above the pubis. In most cases, reduction in the size of the head is sufficient for vaginal extraction but, when there is a marked pelvic contraction, cephalotripsy may also be required. As mentioned before, such cases are best treated by caesarean section but lack of facility in rural practice would need cephalotripsy. The site of perforation should not be a fontanelle or a suture but some part of the parietal, frontal or occipital bone.

Perforation of Normal Head. In Midcavity. When the head is in the midcavity, it can be easily perforated without anaesthesia. The common types of instruments used for perforating the head are shown in (Figs. 206, 207 and 208). The site of perforation does not



Fig. 206. Simpson's perforator.



Fig. 207. Denman's perforator.

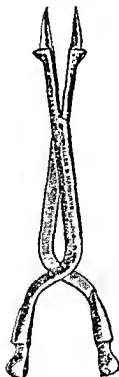


Fig. 208. Oldham's perforator.

need consideration as the head in this position rarely requires cephalotripsy. The head is perforated at a point which is most easily

reached. With all surgical asepsis, dettol is applied to the vaginal wall. The left hand is inserted into the vagina until the finger tip touch the head. The perforator is guided along the fingers in the vagina until it touches the head. The vaginal fingers are kept in position throughout the operation. The scalp is pierced and a hole is made in the bone by a screwing movement. The blades are then pushed in upto the shoulders and opened widely to tear the bone. The blades are closed and the instrument is rotated by a right angle. The blades are reopened to make a wide crucial opening in the bone (Figs. 209, 210, 211 and 212).

The instrument is pushed further into the cranial cavity until the tip touches the base of the skull. The brain matter is cut up by moving the blades in different directions. To make sure that a stillborn child is brought out, the brain matter in the vicinity of

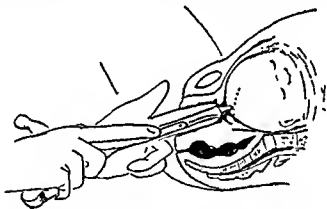


Fig. 209. Applying the perforator to the scalp.

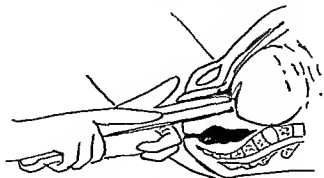


Fig. 210. Perforating the skull.

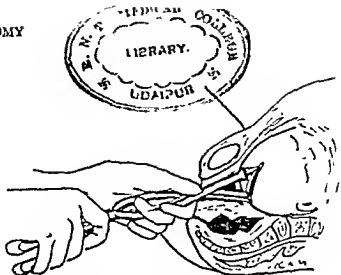


Fig. 211. Widening the opening in the skull.

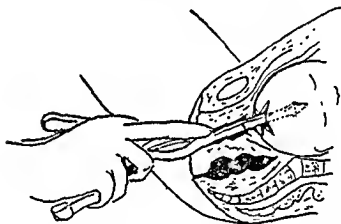


Fig. 212. Destroying the medulla by pushing in the perforator.

the foramen magnum, where the vital centres are located, is thoroughly churned up. The fingers of the left hand and the instrument are simultaneously withdrawn.

Next, a blunt flushing curette is introduced into the cranial cavity and the brain matter is curetted out.

A bulldog forceps is applied to the edge of the perforated bone and continuous traction is exerted.

Perforation of Aftercoming Head. The arrest of the aftercoming head is usually due to (1) breech extraction through an incompletely dilated cervix, or (2) cephalopelvic disproportion at the pelvic brim.

The ease or difficulty with which the occipital region of the

head is reached depends to a great extent on the dilatation of the cervix. At times, the cervix grips the neck so firmly that it is not possible to go above it. As the body is out there is no danger of a normal sized head causing rupture of the uterus and therefore there is no danger in waiting for the cervix to dilate. An injection of 100 mg. pethidine hydrochloride is given and the body is allowed to hang so that there is continuous mild traction on the cervix. Frequently, when the cervix dilates, the head descends into the vagina and is extracted in the usual way. Should the head not descend spontaneously after dilatation of the cervix, an attempt is made to deliver the head in the usual way. When such attempts are unsuccessful, perforation of the head is required.

The head is fixed by an assistant exerting firm downward traction on the body. The occipital prominence and the bone in the vicinity is very thick and hard to pierce. Perforation should never be done near the foramen magnum because there is the danger of dislocating the atlanto-occipital joint and should this occur extraction of the head will become still more difficult. For these two reasons, perforation should be done to one side of the midline. To prevent the perforator slipping off the bone and damaging the maternal soft parts, it is better to incise the skin on one side of the neck and pass the perforator subcutaneously.

At times, it is more convenient to perforate the aftercoming head through the palate. The body is held forward and the perforator is introduced into the palate through the soft tissues under the jaw. Greater force is necessary to pierce the hard base of the skull than that required for the vault, but there is no danger of injuring the maternal soft parts by slipping off of the blades of the perforator.

Cephalotripsy. This operation is seldom performed nowadays in hospital practice. There were only 4 cases in this series of 113 cases in which cephalotripsy was resorted to, successfully in 2 and unsuccessfully in 2. Until the standard of obstetrics in rural areas is raised to a level available in the cities of India, the operation of cephalotripsy must remain the mainstay of treating obstructed labour in outlying rural areas.

Of the two instruments cranioclast and cephalotribe, the three bladed cephalotribe reduces the size of the head much more effectively than two bladed cranioclast which crushes only one-half of the base of the skull (Figs. 213, 214, 215).

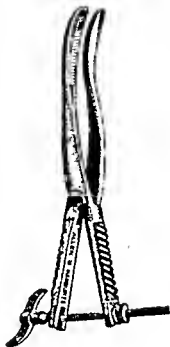


Fig. 213. Braun's cranioclast.



Fig. 214. Braxton Hick's two bladed cephalotribe.

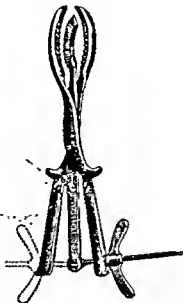


Fig. 215. Winter's three bladed cephalotribe.

Technique. When the **cranioclast** is used, the pointed blade is inserted through the perforation and the point is fixed into the foramen magnum. The fenestrated curved blade is applied preferably to the occipital side because, after crushing the occipital portion of the base, the head can be flexed by traction on the outer blade. When the head has descended into the cavity, crushing of the base by a cranioclast is usually sufficient to extract the child (Figs. 216, 217).

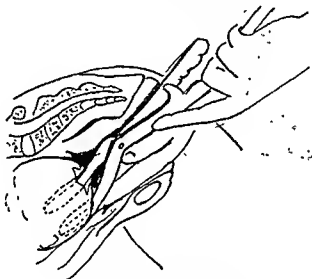


Fig. 216. The cranioclast in position.

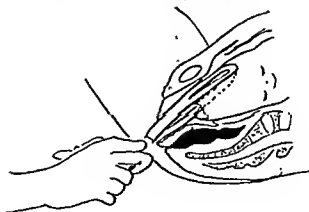


Fig. 217. Crushing of the head by the cranioclast.

When a cephalotribe is used, the central pointed blade is passed through the perforation and fixed to the base. Here the second blade is preferably applied over the face and the frontal part of the base is crushed by turning the butterfly screw. The third blade is now applied to the occipital side and the posterior half of the base is crushed. The baby is extracted by traction on the cephalotribe. If the second blade is applied to the occipital region, flexion of the head will occur which will take the face further away and application of the third blade to the face will become difficult.

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CHAPTER 12

DECAPITATION

Indication. The only indication for decapitation is neglected, obstructed, transverse lie of the foetus.

It may occasionally be necessary in twin pregnancy, when the first foetus in the transverse lie cannot be converted into a longitudinal one by external or internal version.

A rare indication is double headed monster.

It is a difficult operation, particularly when the head is lying high up on one or the other side. The more the labour has been prolonged, the more difficult is the operation, for by then, the liquor amnii has completely drained away and the uterus is firmly gripping the foetus. Although the main purpose of the operation is to prevent rupture by avoiding further distension of the lower segment, the uterus is frequently ruptured by manipulation for decapitation. The uterus, should always be explored immediately after completion of the operation to exclude or to detect a rupture.

Technique. In order to relax a tonically contracted uterus, general anaesthesia is always necessary. A skilful anaesthetist makes the operator's work easy by proper relaxation and, conversely, a bad anaesthesia increases the difficulties for the operator. Spinal anaesthesia is evidently contra-indicated.

As a rule, the arm of the side of the impacted shoulder is prolapsed. A loop of gauze is tied round the wrist of the prolapsed arm. The assistant keeps firm traction on it so as to bring the neck down as low as possible.

Choice of the hand to be introduced will vary. An obstetrician used to working with a right hand only will introduce it irrespective of the head being on the right or the left side. One who is ambidextrous will select the hand according to the position of the head.

A variety of instruments have been employed for severing the head of the foetus from the trunk. The decapitating knife or the saw are commonly used (Fig. 218). Braun's hook is seldom used as the narrow hook is difficult to fit into the curve of the neck. Also, breaking the neck by twist of the hook is not easy.

When the uterus is tonically contracted, it is not possible to



Fig. 218. Decapitation saw.

palpate the foetal parts per abdomen, and only on a vaginal examination can the situation of the head be made out. The hand is guided into the uterine cavity alongside the prolapsed arm, and the apex of the axilla is sought, as the apex points the side towards which the head lies. The intercostal spaces are next palpated and indicate the dorso-anterior or the dorso-posterior position of the body.

Having palpated the foetus, the hand is withdrawn, and the decapitation hook or the saw protected by the palm of the hand, is guided between the shoulder and the pelvic wall upto the neck (Fig. 219). The fingers are now placed behind the neck, and the thumb is placed in front of it. The decapitation blade is now guided along the fingers to the top of the neck. It is then rotated forward through a right angle. The thumb which has been placed in front of the neck feels the point of the blade and guides it into the groove of the neck (Fig 220). The fingers and the thumb are kept in this position and control the sawing movements of the blade so as to prevent any injury to the uterine wall. The sawing movements are continued until the cervical spine is cut through. The

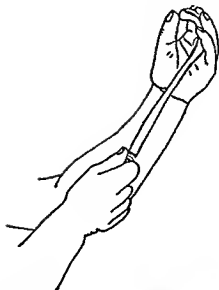


Fig. 219. Method of holding the decapitation saw.

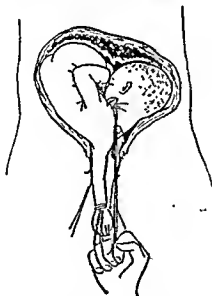


Fig. 220. Decapitation saw applied to the neck.

blade is then gently withdrawn still under the protection of the palm.

Traction on the prolapsed arm now brings the neck within easy reach, and by putting a Sim's speculum into the vagina, the muscles and the skin still attached to the neck are cut off by long scissors. By further traction on the arm the body is delivered (Fig. 221).

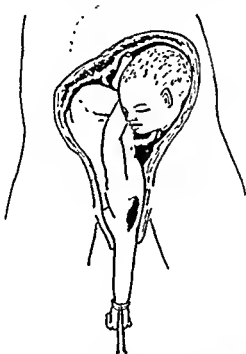


Fig. 221. Extraction of the trunk after decapitation.

The delivery of the retained head is at times easy or may be difficult, depending on the size of the head, the size and the shape of the pelvis and the dilatation of the cervix.

The severed head is delivered by a finger hooked into the mouth, or by applying forceps (Fig. 222). Previously, when the pelvis was markedly contracted, the size of the head was reduced by perforation and the application of a cranioclast, but nowadays such cases are best treated by caesarean section.

Since the delivery of the body reduces the size of the distended lower segment, there is no immediate need for the delivery of the head. If the cervix is not sufficiently dilated, unnecessary manipulation for immediate delivery of the head should not be persisted in. Traction is kept on the head by applying a bull-dog forceps, and the patient is allowed to come out of the anaesthesia. If



Fig. 222. Extraction of the decapitated head by mouth traction.

necessary, an injection of pethidine, 100 mg., is given. After a lapse of some time, the cervix dilates and the head is delivered.

CHAPTER 13

EVIScerATION AND CLEIDOTOMY

EVIScerATION

Evisceration is performed to reduce the foetal trunk by removing one or more of the abdominal or ^{thoracic} viscera. Evisceration is indicated when the size of the foetal trunk is so large that it obstructs delivery after the head or the breech is born.

Operation. Anaesthesia is necessary to relax the perineum. The hand is passed along the ventral aspect of the body and a Simpson's perforator is guided along it. The abdomen is perforated (Fig. 223). If the excessive size is due to foetal ascites, the trunk



Fig. 223. Perforating the abdomen for evisceration.

can be delivered after draining the fluid. In other cases, the opening in the abdomen is enlarged by the fingers and the nearest viscus is caught and pulled away (Fig. 224). In this manner the size of the trunk is reduced by pulling out as many organs as is necessary to deliver the body.

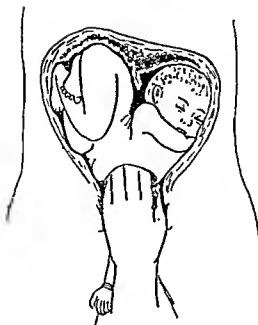


Fig. 224 Removing the viscera.

CLEIDOTOMY

The term cleidotomy is applied to the operation of cutting the clavicles. By cutting the clavicles the width of the shoulder girdle is reduced. This operation is required when, after the delivery of the head, the shoulders obstruct delivery.

Operation. Two fingers are passed into the vagina until the clavicle is reached. Long scissors are passed alongside the fingers and the clavicle is cut.

CHAPTER 14

SHIRODKAR OPERATION FOR REPAIR OF INCOMPETENT CERVIX

Steps

(1) An incision is made at the cervico-vaginal junction. The anterior vaginal wall with the bladder is dissected away from the cervix in order to create a bed for the strip (Figs. 225, 226).



Fig. 225. The line of incision on the anterior surface of the cervix.



Fig. 226. Elliptical incision on the anterior surface of the cervix.

(2) The cervix is held forward and a vertical incision, $\frac{1}{2}$ inch long, is made on the posterior vaginal wall a little above the cervico-vaginal junction. A curved artery forceps is introduced in the incision and opened up to dissect a bed for the strip (Fig. 227).

(3) A Shirodkar isthmorrhaphy needle is passed through the left angle of the anterior incision close to the lateral aspect of the cervix and is gradually worked backwards till it emerges from the posterior vertical incision. The thread attached to one end of the fascial strip or Mersilene tape is threaded into the eye of the needle and as the needle is withdrawn the strip is pulled in and is brought out of the left angle of the anterior incision (Fig. 228).

(4) The isthmorrhaphy needle is passed through the right angle of the anterior incision and made to emerge from the posterior vertical incision. The thread attached to the other end of the strip or tape is threaded and the needle is withdrawn. The fascial



Fig. 227. Vertical incision on the posterior surface of the cervix.



Fig. 228. Shirodkar isthmorrhaphy needle passed through the left angle of the incision and the Mersilene is threaded into the eye of the needle.

strip is pulled in and brought out through the right angle of the incision (Fig. 229).

(5) The two ends of the fascial strip are tied together with a reef knot. The reef knot is transfixed at two or three places with linen sutures (Fig. 230).



Fig. 229. Isthmorrhaphy needle passed through the right angle of the anterior incision. The thread attached to the other end of the tape is threaded into the eye of the needle.



Fig. 230. The ends of the fascial strips are seen in the anterior incision.

(6) The incisions in the anterior and the posterior vaginal walls are closed by catgut sutures.

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